EDITORIAL

WHAT has become of the 'Little Navy' Congressmen and Senators?

JAPAN has asked for an increased allotment of space at the Panama-Pacific Exposition. The Orient at least will make exhibits that will be all the more notable by the possible absence of some of the European nations.

PROSPECTIVE bidders on the San Francisco Twin Peaks Tunnel project found that the war in Europe was not of much help when it came to seeking financial backing for a 50 per cent bond guaranteeing successful fulfillment of a $3,500,000 contract.

IT has been freely predicted that the attendance at the Panama-Pacific Exposition in 1915 will be at least as great as if the war in Europe had not occurred. Americans who have been in the habit of spending from $200,000,000 to $300,000,000 annually at the watering places of the Riviera and the shops of Paris will now act on the suggestion to 'See America First.'

THOSE who may be inclined to show symptoms of panic over the unrest occasioned by the war in Europe, might do well to read the interview with Mr. Franklin K. Lane published in this issue. The sooner the tendency to hoard money is succeeded by a realization of the opportunity to develop our own country, the better for all concerned.

ANOTHER instance of the excellent judgment of the President is his refusal to authorize American bankers to make war loans to any of the belligerent nations of Europe. At the same time, he might have pointed out that such idle funds as might be at the disposal of American capitalists could find ready and profitable investment here at home in building up American industry to the point of absolute independence from all external sources of supply.

ANOTHER ruling by the California Railroad Commission has been made regarding the relation of public utility corporations to the communities which they serve. In the case of the Vallejo Light & Power Company, brought before the Commission on complaint of the Vallejo Trades and Labor Council, the former maintained that it should only be required to make extensions when such extensions would show a profit. The Commission ruled, however, that the Company must extend its service to a thinly populated district of a city, provided its business as a whole is in a prosperous condition, and that it may not wait until the number of consumers in a neighborhood would be sufficient to justify a profit.

IN these days of war, the achievements of peace seem almost forgotten. On August 15 the Panama canal was thrown open to vessels of 30-feet draught and less. Americans interested in making a genuine effort to obtain their share of the South American trade will find the opening of the canal at this time to be most opportune. Ships under the American flag carrying American goods through the Panama canal should make a combination hard to beat.

REINFORCED concrete pipe is not new; in fact, it is rapidly becoming popular for many purposes. In the case of the conduit for the Sooke water-supply described in this issue, not only the pipe proper, but the trestle and all parts of the supporting structure were made of reinforced concrete. The engineers in search of a type of construction that might be considered as permanent, were not guilty of the inconsistency of placing reinforced concrete pipe on a wooden supporting structure.

THE problems entering into the management of an irrigation project differ radically from those of design or construction. Mr. F. H. Newell, director of the United States Reclamation Service, discusses the many conditions that confront the man who undertakes the management of a project designed and built by another, so that those who run may read and profit greatly thereby. Mr. Newell speaks with authority, and in thus giving of his store of knowledge and experience for the benefit of others, he has earned the thanks of those who stand to profit by taking advantage of this opportunity.

THE forthcoming meeting of the American Road Congress at Atlanta, Georgia, to be held during the week of November 9, will have as its presiding officer Mr. Austin B. Fletcher, chief engineer for the California Highway Commission. Among the more important topics to be discussed will be 'Systematic Road Management,' involving the organization of working forces and the methods of accounting, and recording and reporting work. The paper has been prepared by Mr. Charles J. Bennett, state highway commissioner of Connecticut, who by reason of his comprehensive experience, is in a position to speak with authority. Advance notices of the program indicate a session of exceptional interest, and road engineers

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in the West who can spare the time will find it to their decided advantage to learn at first hand of the methods in vogue in other sections of the country.

NOW is the time for government action toward clearing up the fog existing in the minds of business men as to the attitude of the Government toward business. Until a definite understanding is reached as to what is and is not according to law, stagnation will continue to exist as far as the promotion of new enterprises is concerned. Let us hope that government by theory may soon be succeeded by practical understanding and a desire to build up rather than tear down.

ON August 15 the Church temporary oil land relief bill reached an agreement among the House and Senate conferees, and will become a law as soon as it is signed by the President. The new law will permit all claimants to oil land titles, while awaiting a settlement, to continue production on payment of a royalty of one-eighth of their production to the Government. Those to whom a valid title is finally granted will have royalties refunded. Many of the operators in Kern and Fresno counties who have been completely tied up by litigation with the Government will be able to resume operations.

ANOTHER event of the past month that is worthy of more than passing notice is the completion of the 400-mile transmission line of the Nevada-California Power Company, the longest electrical transmission in the world. On August 13 the line was placed in operation, the initial load being 2000 horse-power of a total capacity of 10,000 horse-power. The line extends from the high Sierras in California near the Nevada line, through the desert country of Inyo county, then into San Bernardino county, and terminating at El Centro in the Imperial valley. There are central distributing stations at Banning, Coachella, Calipatria, and El Centro. In these the usual transformers are placed and power is distributed over branch lines to consumers. The greater part of the electric energy thus brought from the mountains will be utilized for the operation of pumps in irrigation work. In this way the desert regions of California are fast being made to yield their potential wealth, and the term desert will soon be no more than a memory.

The San Francisco-Oakland Bridge

Residents of San Francisco and the east bay shore have often debated the question of the possibility of bridging San Francisco bay. In the absence of designs, figures of cost, and possible revenue from so colossal a structure, such discussion is fruitless. In this issue, Mr. Charles Evan Fowler, of Seattle, who has specialized for years in bridge building, has contributed a paper that gives at last a definite basis for discussion.

The figures of size at first seem appalling. When one considers spans of 2300 feet, a height of 150 feet in the clear above high tide to permit the free passage of vessels, and foundation piers at a depth of 150 feet below the water, some of the conditions under which the structure must be designed are brought vividly before us. Perhaps the best idea as to the relative size of the structure is given in the illustration shown on page 101. A standard railroad train is shown traversing the bridge, and an ocean liner about to go under one of the great spans.

Apart from the engineering features which Mr. Fowler in his preliminary scheme has treated at length, the question of paramount importance is one of finances. How much will it cost, and will it pay? It is admittedly a job of at least ten years duration, and assuming that the work were undertaken immediately, what revenue might be expected when the bridge is ready to go into commission?

The rate of increase of population, freight, tonnage, and automobile traffic may be taken for the last ten years and from that a curve plotted and extended into the future. This done, it may be shown that in 1925 the traffic and revenue would be approximately as follows:

Passengers, annually	60,000,000 at 5c.,	$ 3,000,000
Automobiles and teams..	5,000,000 at 20c.,	1,000,000
Freight, tons	56,700,000 at 10c.,	5,670,000
Wharf space, sq. ft.....	2,650,000 at 20c.,	530,000
Gross total revenue per annum.....		$10,200,000

In terms of a percentage, this is equivalent to 13½ per cent gross return on an investment of $75,000,000. Allowing say 7½ per cent per annum to cover overhead charges, maintenance, upkeep, and depreciation, the net return that could be made in the form of dividends to stockholders would be 6 per cent from the time the bridge was placed in commission. These figures are, of course, merely tentative, and any calculations from an economic standpoint would have to take many other factors into consideration, such as interest on money not returning any earnings during the long period of construction. Nevertheless, is the idea such a dream as it would appear at first glance? When the first Brooklyn bridge was constructed, it was regarded as the crowning engineering achievement of the age. Now there are so many similar structures radiating out from Manhattan Island that their novelty has long since passed away. It is true that spans of 2000 feet in length have never heretofore been attempted. On the other hand, if engineering depended upon precedent, there would be no progress, and in fact there would be no world as we know it at all. It is to the credit of the American people, and of the American engineer in particular, that 'It is done' has been substituted for the former 'It can't be done.' A Nation that can build a Panama canal or a Woolworth building need not balk at a bridge over the San Francisco bay.

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REVIEW OF THE MONTH

AMERICANS, in the rôle of spectators, stand aghast at the terrible spectacle of a general European war. Washington, on the occasion of the birth of the Nation, warned the colonists of 1776 to beware of entangling alliances with Europe, and the present generation may well pay tribute to the memory of the man whose foresight promulgated a policy that has since been consistently maintained. Nevertheless, while we are spared the physical and visual horrors of war, and can express the keenest sympathy with the millions of people whose friends and relatives have gone forth to slaughter, modern progress and methods of communication have been brought to such a state of perfection that commercial and business America faces a complete upheaval by reason of the absolute stoppage of the ordinary channels of trade. The telegraph, the fast steamers, and even more, intricate financial relations have so inseparably interwoven our affairs with those of the nations of Europe that any catastrophe affecting one affects all.

FIRST of all, the United States faces a deficit in custom receipts of some $100,000,000, due to the stoppage of importations, and ways will have to be determined to provide funds for the maintenance of the Government from some other source. A direct tax upon certain luxuries has been proposed and will probably be levied. Judging by the enormous increase in the number of pleasure motor cars in use, why not impose a slight tax on gasoline? California with more than 110,000 motor cars in use, would then be paying a good share of the expense of maintaining the Federal Government, and an extra charge of 1 cent per gallon for gasoline would not be a serious burden upon the motorist, nor cause him to place his car in storage until the war is over. In any event, the ultimate consumer pays, whether in the form of a higher price for the privilege of imbibing the vintage of Rheims instead of California, or for a foreign label on the spring hat or gown.

THE stoppage of foreign imports, however, takes a more serious aspect than a shortage of French hats and wines. Potash, the base for practically all fertilizers, comes, or rather came, from Germany. Much of our supply of quicksilver came from the famous Almaden mines of Spain. And so it is with many of the useful and necessary commodities of life, as well as those that may be classed as merely ornamental. The foreign markets for our wares are just as tightly sealed as our markets are to Europe. An immediate manifestation of this is found in the curtailment of the output from all of our great copper mines. In the Lake Superior region, so many men have been thrown out of work that the state government has under consideration the inauguration of a comprehensive program of road building in order to allay the hardship and suffering among the former copper miners. The larger manufacturers of machinery, of which there have been a few strong enough to attempt to do business in foreign markets in competition with their low wage scales, will also feel the effect of the changed conditions.

ANOTHER commodity that we have been importing in increased amounts, especially in California, is money. This we are going to miss more than anything else, until we have learned to finance our enterprises at home. The California oilfields have been receiving much attention from foreign investors during the last two or three years. The activities of the Royal-Dutch Shell interests, a combination of Holland and English capitalists, are too well known to require comment. A contract was let some weeks ago for their new pipe-line from Coalinga to the San Francisco bay. Contract for the boilers for the pumping stations has also been let, and that for the pumps is pending. That the war may retard the work, while not officially announced, is most likely. The Union Oil Company has granted an extension of time, until April, 1915, to the syndicate headed by Mr. Andrew Weir, which had under option the purchase of their entire property. Plans for refinancing the Natomas Consolidated had progressed well in London under the guidance of Mr. H. C. Hoover, but whether they had gone far enough to proceed to a conclusion without any interruption, is a question.

THERE is another phase of the matter, however, to which Mr. Franklin K. Lane, Secretary of the Interior, directs attention in this issue, and that is the possibility of the substitution of the label 'Made in the United States' instead of 'Made in Germany' or 'Made in France.' This country is so wonderfully rich in natural resources that there are countless opportunities within our own borders that offer the best possible inducements to capital, and which have been either overlooked or neglected. The American people are an easy-going lot, in spite of their boasted energy and strenuous life, and seem in many cases to prefer to buy goods of foreign manufacture because perhaps they have been apparently cheap, and in some cases superior in quality to those turned out by the sporadic efforts of such Americans whose efforts to

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compete failed from lack of support from their own countrymen. Now this is all changed. Americans will have to buy and sell to one another or do without. That this state of affairs will be productive of much good cannot be doubted.

GREAT changes industrially are about to take place in the United States. The greatest of these, perhaps, will be the increased interest taken by capital in the development of our mineral resources. Manufacturing also, in search of a market for its product, will probably have to curtail its output in some lines but increase it in many others. It has been an interesting situation, for instance, in which Germany for some years has been able to export certain classes of machinery into the United States, pay an *ad valorem* duty of 40 and later of 25 per cent, and still undersell American manufacturers of the same goods. Patriotism is a great asset to a people, but will seldom stand the test of having to pay higher prices for American-made goods. Now that, at least temporarily, foreign competition has been stilled, American manufacturers should wake up to their opportunities, improve their methods, and modernize their factories, so that when European competition again becomes a factor to be reckoned with, the American manufacturer will have become so strongly intrenched that he cannot be dislodged.

AS a first aid to the promotion of the 'Made in the United States' movement, the President has signed the emergency shipping bill admitting to American registry foreign-made vessels. Coincident with this, a project is under way looking toward the purchase by the United States of the large number of merchant steamers now lying in New York harbor and belonging to the Hamburg-American Steamship Company. There will also be a rush to obtain American registry for the great fleet of tramp steamers that in the past has been handling the ocean-going freight traffic of the United States under foreign flags. Especially with respect to South America is our opportunity great. Few people realize to what an extent Europe has monopolized trade with our neighbors on the south; trade that logically should belong to the United States, not only because of our geographical position, rendered still more favorable by the completion of the Panama canal, but by reason of the protection from foreign aggression guaranteed by the maintenance of the Monroe doctrine.

WE have much to learn about the proper conduct of foreign business, and must realize that we must adapt ourselves to the buyers' requirements rather than try to force our own views. Americans who have attempted to engage in the export business have been surprisingly slow in learning these things, and it is especially in their readiness to adapt themselves to any set of conditions that the German has proved himself to be the better business man in dealing with other nationalities. Where the German will send his most skilled salesmen to study the needs of a community, the American will insist upon having his own way or abandon the attempt to extend his business. For instance, an American addressing a communication to a German concern, will write in English. The German, on the other hand, will invariably use the language of the person whom he is addressing. It is not surprising that American business houses lose much business in consequence.

OPPOSITION to the movement for the registry of foreign-made vessels under the American flag made its appearance during discussion of the measure in Congress, as fear was expressed that the monopoly of the coastwise trade so long enjoyed by American bottoms would be destroyed. Wiser counsels prevailed, however, as the necessity for moving the bumper crops of this season was paramount to any sectional consideration. Government assumption of war risk insurance is another of the many interesting possibilities brought about by the war. The administration has been in conference with leaders in the Senate and House to devise legislation providing $5,000,000 to be utilized as capital for this purpose. The records of the Geological Survey are at the disposal of prospective developers of our mineral wealth, and the admirable work done by this branch of the Government service will receive the recognition that is its just due. 'See America First' will be the rule for some time to come, while the label 'Made in the United States' may yet become a familiar sign among the nations of Europe.

EXCELLENT progress is being made in the construction of the new California State Highway. Thus far, 119 miles has been completed and 392 miles is under construction, making a total of 511 miles of new roads completed within less than a two-year period. The total cost for the completed roads is $965,566.94. This total includes all preliminary as well as the actual construction work. A total of $4,400,358.55 represents the cost of highways that have been constructed, in which is included $3,434,791.61 for contracts now under way. An estimated mileage of 2025 is yet uncompleted, making the entire system to be constructed under the plans of the State Highway Commission 2536 miles. Of the total bond issue of $18,000,000, $9,785,000 has been sold, and of this amount $3,462,200 has been expended for all purposes. The greater part of the roads constructed and under construction is of the oil and portland cement concrete type. The mileage of each type, with the exception of the graded roads, is: asphaltic macadam, 16.54 miles; asphaltic concrete, 12.54 miles; oil macadam, 19.12 miles; water-bound macadam, 19.48 miles; graded roads, 73.58 miles; and portland cement concrete with oiled surface, 369.04 miles.

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San Francisco Cantilever Bridge

By CHARLES EVAN FOWLER*

The problem of bridging San Francisco bay from San Francisco to Oakland has been uppermost in the writer's mind for nearly a quarter of a century, or since his employment nearly twenty-five years ago in designing much of the steelwork on the Mills building, San Francisco's second steel-frame building, and later, many bridges, including a number of the notable bridge structures of the Pacific Coast, Alaska, and other portions of the United States.

Having to solve the problem in a preliminary study some months ago as to the possibility of crossing the bay for a comparatively low cost, and finding this to be out of the question, it has seemed advisable to elaborate the design that was found to be most desirable and to call the attention of those interested from both an engineering and financial viewpoint to the feasibility of a structure costing about $75,000,000.

Such a structure is shown in Fig. 1 to 6, and consists of a main bridge from Telegraph hill to Goat island, with three main spans of the notable length of 2000 ft. each, with a clearance at high tide of 150 ft., which are the least dimensions that it seems advisable to consider with the present and prospective future traffic on the bay. The approach from Oakland to Goat island has a length of over 20,000 ft., and a cantilever span of the very considerable clear span of 800 feet.

The suspension designs that have been proposed are of the general type shown in the writer's design for such a structure Fig. 7, with three main spans of 2400 ft. each.

The plan for a cantilever structure with anchor arms at Telegraph hill and Goat island, Fig. 7, calls for three main spans of 2300 ft. each, the anchor arms being 900 ft. each in length, and the suspended spans 800 ft. each.

The plans that have been considered for a crossing of the bay by means of a tunnel call for an expenditure of not less than $25,000,000, but in the writer's opinion this would not represent one-half the cost of the project proper, to say nothing of the untold millions that would be necessary for future expansion of the terminals and to bring them up to traffic capacity of the proposed cantilever bridge. However, after the city's experience with its water system some years ago, we are warranted in dismissing a tunnel project as entirely unsafe and unsuitable for a location with the well known seismic conditions that have to be provided for in any class of structure.

The suspension design and that for cantilever spans of 2300 ft. may be dismissed for like reasons, and for the added ones of greatly increased cost over the design with 2000-ft. spans.

The capacity of a bridge which will carry, by the time it is completed, in excess of 60,000,000 people a year, and about 56,700,000 tons of freight per annum, must be not less than 18,000 lb. per lineal foot, or 4000 lb. on each of two steam railway tracks, 3000 lb. on each of two electric tracks, and 2000 lb. on each of two 20-ft. roadways, although the main cantilever trusses would be figured for a smaller uniform load.

The main spans will be divided into two 650-ft. cantilever arms and a 700-ft. suspended span, while the shore arms and shore spans will be of similar lengths. The depth at the ends of the cantilever arms will be 75 ft. at the centre of the suspended span 135 ft., while the towers will have the great height of 450 ft. centre to centre of chords, or a total height, including the 50-ft. finials, of 500 feet. To provide for sidewise stability, while the clear space between trusses of the suspended spans is 65 ft., the clear width at the towers is 126 feet.

The outline of the trusses and cantilevers has been adopted not only for economical reasons, but to provide a structure of pleasing design. The comparative outline of the great Firth of Forth bridge, increased proportionately, is shown superimposed upon this outline (Fig. 4), and brings out clearly the necessary increases for a structure of such great magnitude and capacity as the one proposed.

The foundations for such an enormous structure require special designs for the separate piers, four in number under each tower, some of which may be sunk by the pneumatic process and others by specially planned open dredged caissons, with special details for stability as indicated. The piers will all be frustums of cones, to give the necessary spread for the bearing of the piers on the bottom. The tops of all the piers are designed as shown in Fig. 5, so that the pressure from the steel shoes of the trusses will be properly distributed through the 35 ft. of granite to the concrete filling of the caissons.

The steelwork of the cantilever spans is of such unusual magnitude that ordinary, or even recent unusual designs have been found inadequate. The first panel of the cantilever is carried directly from the towers as shown in Fig. 2 and 5, thus making the remainder of the cantilevers and suspended spans of simple, single intersection type.

The outline obtained by the curved chords is certainly more pleasing than that of many of the other great

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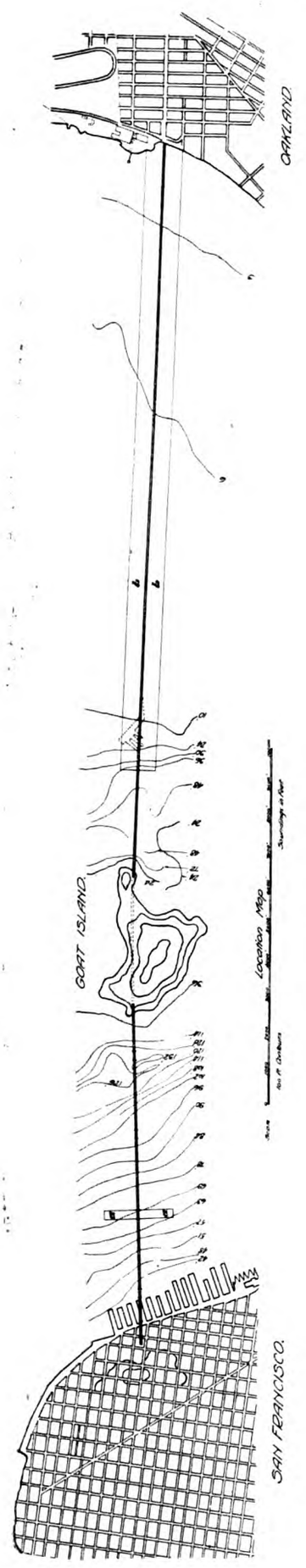
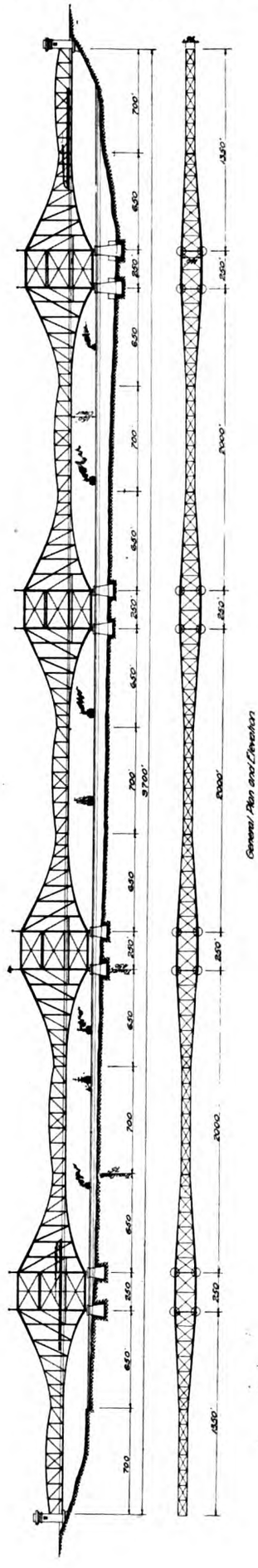


FIG. 1, LOCATION MAP.



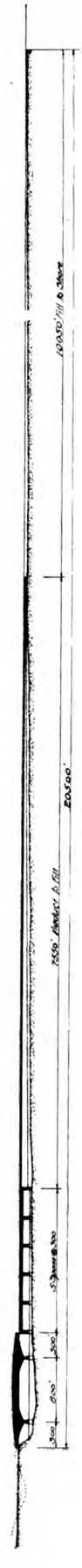


FIG. 2, GENERAL PLAN AND ELEVATION. FIG. 3, GENERAL PROFILE OF APPROACH.

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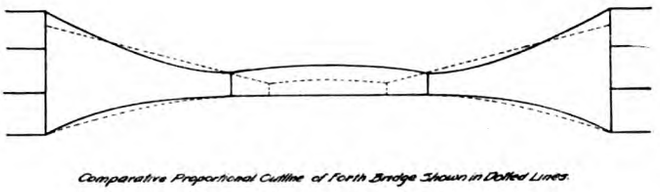

FIG. 4.

bridges of the world, and does not depart materially from the proper economical or practicable depths.

The ordinary type of compression chord members is entirely out of the question for the enormous stresses to be provided for, both on account of lack of economy and also of practicability for such great areas of cross-section. The chords of the Queensboro bridge in New York have a maximum area of 1120 sq. in.; the Hell Gate or Lindenthal 1000-ft. arch, a chord area of 1437 sq. in.; and other recent large structures call for from 1500 to 3000 sq. in. of section for the compression chords. The rectangular form is not considered on account of its lack of economy and of inherent stiffness, and the circular type used on the Forth bridge is not considered advisable on account of the difficulty of making connections to it and the fact that it cannot readily be fabricated in shops, but must be built up piece by piece in the structure. Such a type of chord has, however, the most effective disposition of material of any yet designed, and the form of cross-section adopted for the proposed 2000-ft. spans, while an entirely new one, comes very closely to the same economic disposition as the circular form. This cellular octagonal section, Fig. 6, of 3600 sq. in. can moreover be fabricated in segments in a shop, can be connected to as easily as the rectangular form, and can be easily constructed with cross-sections ranging from 3000 up to 5000 or 6000 square inches.

The bulging caused by building the chords out from 50 to 100 ft. beyond supports is taken care of by the diaphragms and stay bolts, while the bending stresses can be provided for by the extra 50-in. flange plates shown top and bottom.

Where it becomes necessary to provide against distortion of the separate faces of the octagon, small diaphragms may be used, attaching to the stiffeners of the longitudinal sections. Connections for web members can easily be made by internal diaphragms across the diameter of the octagon. Painting can be easily taken care of by manholes spaced at proper intervals.

The ordinary type of shoe, carrying the trusses on a huge pin, is also considered to be impracticable for a

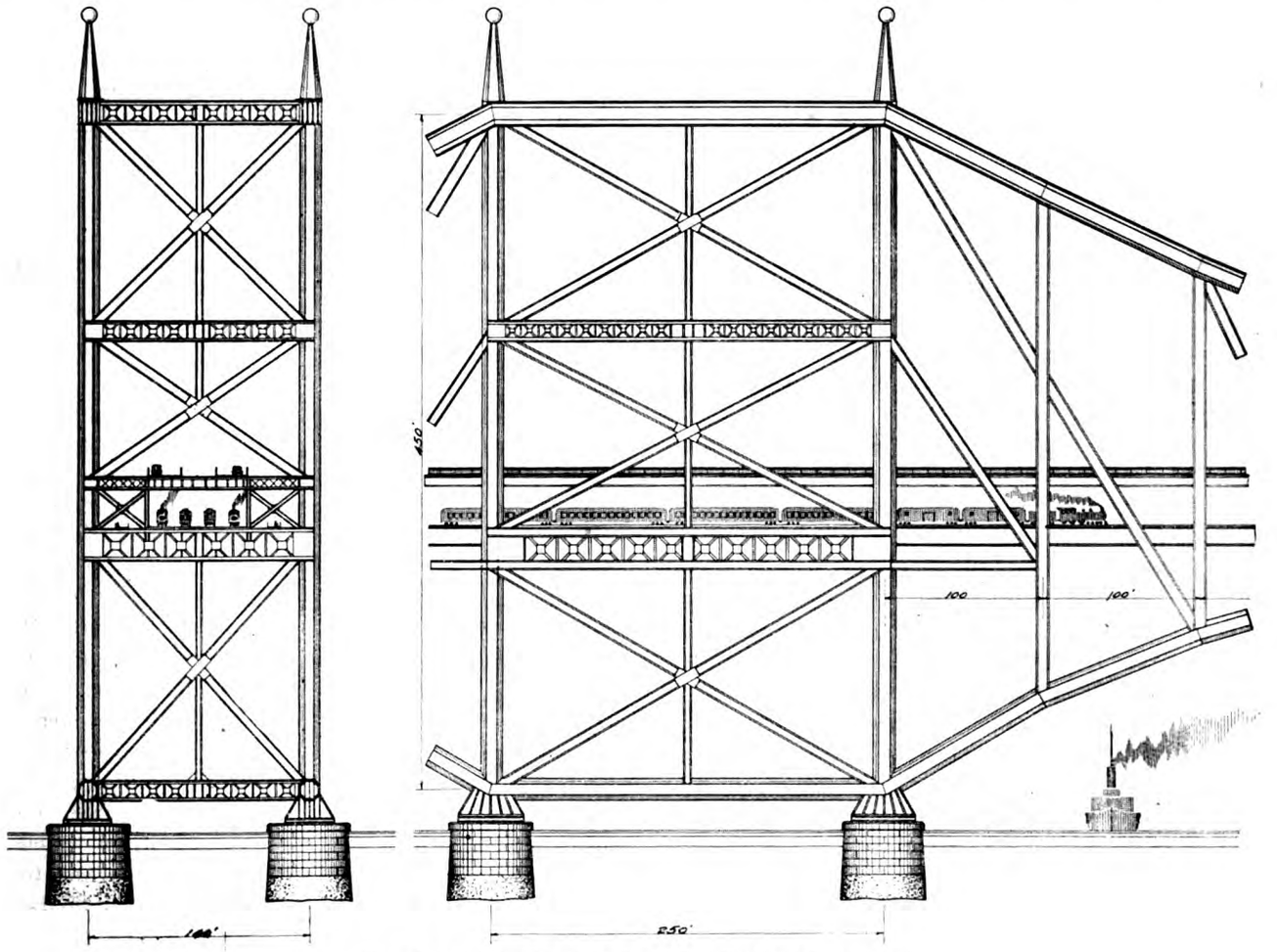

FIG. 5, SIDE AND END ELEVATION OF PIERS AND TOWERS.

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structure of such magnitude, and a shoe built on the tower posts and bottom chords is employed with the shoe plate planed to a vertical curve of long radius to take care of the distribution of the load on the piers due to the deflections of the 2000-ft. spans. The use of nickel steel in the suspended spans and long tension members of the cantilevers, and of high carbon steel in the large compression members will make a structure of comparative lightness, to what was possible in the Forth bridge or many of the other long span bridges.

The crossing of Goat island can be made by a very reasonable amount of excavation for the four tracks and two roadways, the excavated material being used for filling in where the grade is above the present surface, and for filling in at the west of the island in shallow water. By a very large amount of excavation above grade, the land could be leveled off for yards and the filling could be carried on to greatly increase the land area.

The approach from Oakland to Goat island would be no small structure, having the tracks on a fill for nearly two miles, then a steel viaduct 7550 ft. long on filled ground, with steel spans and the cantilever structure for the remaining 2900 ft. The fill would be wide enough out to the steel spans on the Oakland side to provide wharf room on both sides, with trackage for the transfer of freight from rail to vessels. This is shown in Fig. 1, *b-b*, and at *a-a*, Tower 2, are shown two 1000-ft. wharves 300 ft. wide, of permanent construction, where workshops would be maintained for the construction of the bridge. Later on, these would be used for the transfer of freight between river, coastwise and ocean going vessels, thus adding greatly to the revenue of the structure of these wharves *a-a* and the wharves *b-b* as well. Access could be had to these by elevators from the bridge.

The question of terminals is a paramount one in any great structure, and while such facilities could be easily provided for at grade and at one-story elevation on the Oakland side, much more elaborate ones would have to be provided for at Telegraph hill in San Francisco, at an elevation of 165 ft. above the level of the bay. The statement has been made from an authoritative source that the Pennsylvania Railroad Co. has found from experience in New York City that elevated terminals from a bridge would have proved much more satisfactory than the underground ones they have been forced to use in connection with the tunnels. Careful study will usually corroborate this for any locality where there is a large traffic to handle, and a necessity for future expansion.

The San Francisco terminals on Telegraph hill would be provided with huge elevators, each large enough to carry several carloads of people at one time, and land them to and from the car lines on Battery, Sansome, Montgomery, and Kearny streets. Car lines on the adjacent cross streets would also be easily accessible and no difficulty would ever be experienced in handling any volume of suburban or through passenger traffic. Express service could be operated to and from various points on Market street on elevated tracks. Through traffic to and from the south would be handled on elevated tracks on such streets to the southward as could most readily be adapted to such uses, and branches could be run to Third and Townsend streets or such other subsidiary stations as it might seem advisable to maintain or create. Automobile traffic could be handled by comparatively easy grades from Telegraph hill in such directions as would cause little or no congestion from this source.

The rapid growth of the traffic across the bay is shown from the facts that in 1873 the number of passengers carried across the bay was slightly over 2,650,000; in 1877 over 5,570,000; had increased by 1912 to about 40,000,000, and in 1913 to 41,426,014. Present indications are that this will increase at an average rate of not less than 2,000,000 per year for the next ten years, thus justifying the statement, made earlier in this report, that by the time a bridge would be completed, the annual number of passengers would be in round numbers, in excess of 60,000,000.

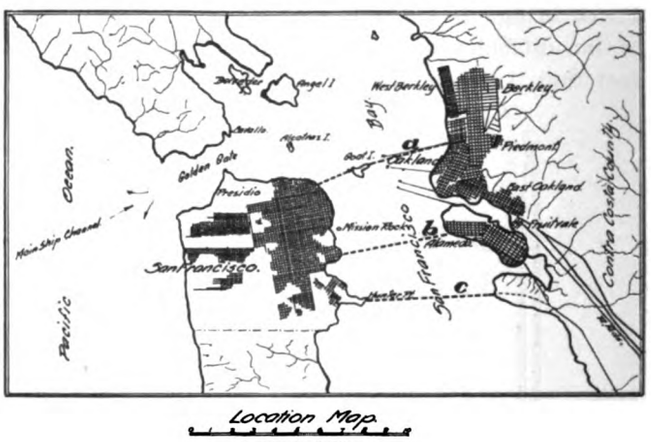

FIG. 8.

The writer has pointed out, in a recent number of the 'Transactions of the American Society of Civil Engineers' that "long spans are seldom contemplated or built from motives of economy, but are the result of the necessities of commerce, of finding good foundations, or as necessary connecting links in lines of traffic and communication regardless of whether the structure in itself will be a paying investment. When long spans from some cause or other are found to be necessary, then the engineer must determine the class of structure that will be possible, first, to carry the class and amount of traffic imposed or cared for; second, that will be possible, due to the foundations that can be obtained; third, that will be possible, due to the material which can be obtained from which to fabricate it; fourth, that will be possible owing to the limitations that may be imposed by the methods and means of construction; fifth, that will be a paying investment from a dividend paying standpoint, if that

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be necessary; sixth, that will at least be possible from related financial conditions. These factors are all correlated to such an extent that a very wide investigation is necessary to set the limits of span and expenditure."

It is believed from the investigations already made as to the cost of the structure, and of the probable earnings by the time of its completion in about ten years, that the bridge terminals and accessories would prove a paying investment on the estimated cost of $75,000,000, which is exclusive of the re-arrangement of street car lines and elevated tracks, but which includes interest, fixed charges, engineering and superintendence.

Terminals, San Francisco and Oakland	$ 4,500,000
Oakland fill and viaduct	7,700,000
Oakland spans and cantilever	6,080,000
Goat island crossing	150,000
San Francisco cantilevers	48,870,000
Tracks for structure	400,000
Engineering and fixed charges	7,300,000
	$75,000,000

The location of this crossing is shown on the vicinity map at *a* in Fig. 8, while other possible crossings are shown at *b* and *c*.

The structure which has been described for location *a* at Goat island, would take care of the traffic from the Southern Pacific, the Santa Fe, and the Western Pacific railways, with a minimum of expense and delay from their present terminals, and would moreover, care for the suburban traffic much better than any other location that could be chosen.

The other two locations, shown on Fig. 8, *b* and *c*, would both cause great inconvenience and delay to the suburban traffic, to such a great extent in fact as to make them practically out of the question. The steam railway traffic would be fairly well provided for at location *b*, but would be very poorly taken care of by such a crossing as *c* at Hunter's point. The crossing at Potrero would have a total length, including approaches for a high level bridge, of approximately 7 miles and would cost nearly 90% of the bridge designed for location *a*. This includes an 800-ft. cantilever span and has four tracks and two roadways of the same capacity as the great bridge we have been considering. To construct a low level bridge, with a movable span for navigation would very materially reduce the cost of the bridge, but would add to the cost of approaches and terminals, and seriously interfere with commerce on the bay. The crossing at Hunter's point with a high level bridge would have a total length, including approaches, of over 10 miles, and would cost about 94% of what has been estimated for the design for the crossing at *a*. We may therefore conclude that no other location than that at Goat island will satisfy the demands of the traffic, nor will prove to be much cheaper in first cost for a bridge of the same capacity, and that will present little obstruction to ocean commerce.

The cost of such a structure at first thought seems prohibitive, but we must consider that at least three great transcontinental railways are to be served, that the urban and suburban traffic of great cities is to be

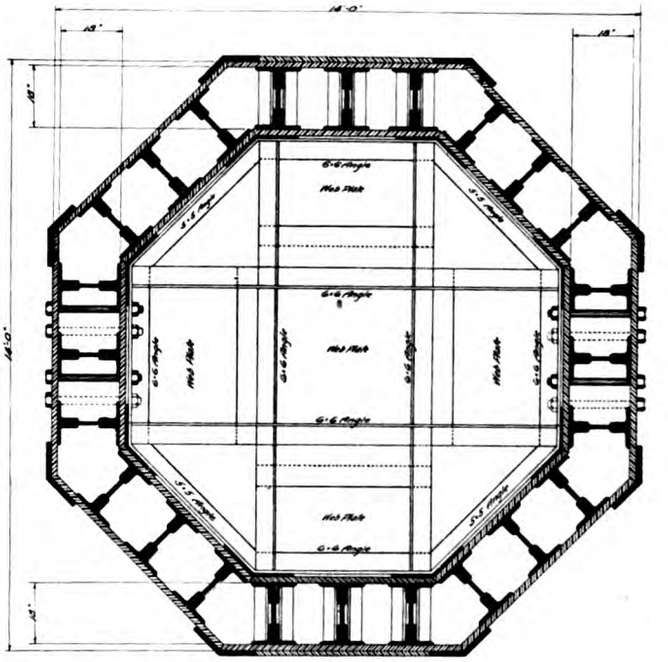

FIG. 6, TYPICAL COMPRESSION SECTION.

Material.	Sq. in.
8 plates 1¾ x 70	980
8 plates 1¾ x 54	770
2 plates 1½ x 50	150
8 plates 1 x 26	208
8 plates 1½ x 21	252
24 plates 1 x 18	432
96 angles 6 x 6 x ¾	810
Total area	3602

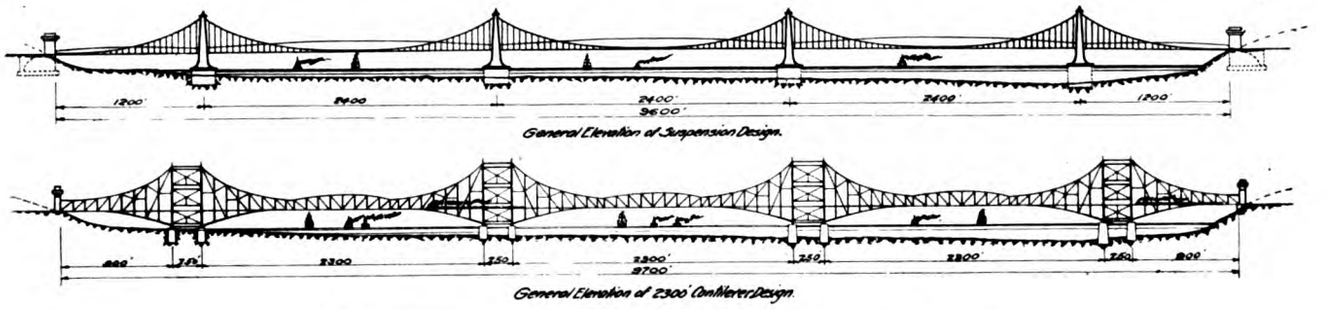

FIG. 7, GENERAL ELEVATION OF SUSPENSION AND CANTILEVER DESIGNS.

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cared for, that a rapidly growing trade from many counties is to be provided for and fostered, that the needs of one of our greatest states are to be subserved, that great sums must be expended in a futile and passing effort to care for ferry and street car traffic, and that eventually something must be done to make traffic routes safer and more expeditious for vessels.

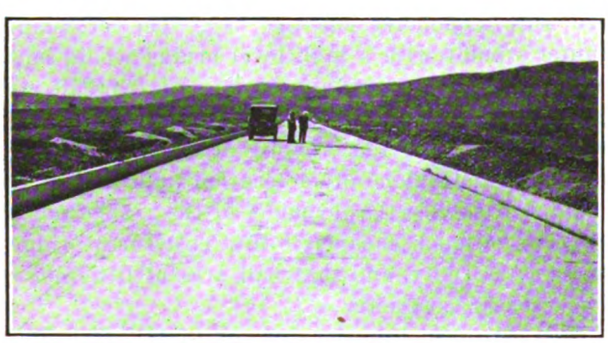
It is obvious that the cheapest thing to do is for the many interests concerned to join forces in constructing a crossing and terminals that will, if begun at once, no more than be adequate by the time it is completed ten or twelve years from now to take care of traffic which will have grown to enormous proportions.

Should the cost run to $100,000,000, it will prove to have been the only thing to do, and but evidence the wisdom and foresight of those having the best interests and welfare of greater San Francisco and San Francisco bay at heart.

Combination Storm Drain and Road

About 18 miles east of Los Angeles is a large tract of land now being subdivided for small ranches. The nearby hills send great volumes of surface water through the 5 and 10-acre tracts about two days a year. A method for taking care of the runoff was devised and constructed in August 1913, and proved to be much cheaper than draining the surface water by the usual storm drains and then constructing a pavement. Calculations determined the amount of water traveling toward the low point, and the combination storm drain and pavement described below is expected to meet both requirements. It was considered that a flooded street for a few days in a year in a rural section with a good footing properly confined was not a serious inconvenience.

SECTION OF ROADBED.



VIEW OF COMPLETED ROAD.

The concrete curb is 12 in. high and monolithic with a 4-in. 1:2:4 gravel concrete 24-ft. flat road-bed. The curb is 5 in. thick at top battered to a 12-in. section at bottom of pavement. At street intersections the curb flares out, and the effect is somewhat that of a saucer.

Expansion joints are at right angles every 25 ft. and the entire roadway is covered with Ott 95% wood oil spread ½ gal. to the yard, upon which is placed sand and, later, crushed rock screenings. The fine material is scattered lengthwise over the road, thus eliminating slight waves on the surface.

The Davidson Construction Co., of Los Angeles, performed the work under the supervision of J. F. Smith. The road is 4500 ft. long. Paving cost 12c. per square foot., curb 30c. running foot. The experiment is a result of the observations of E. G. Haeb, owner of the land who has employed the method of surface drainage used in old Mexico cities. The engineering feature was worked out by F. H. Joyner, county highway engineer, who furnished this data.

Cost of Laying Pavements in Portland, Ore.

At the request of the Oregon Railroad Commission, City Commissioner Dieck has prepared an estimate of the cost of laying pavement between street car tracks in Portland on the lines of the Portland Railway, Light & Power Company.

The report has been filed and shows the following to be the estimated unit cost to the Company without added profit:

Classification.	Unit.	Quantity.	Unit cost.
Stone block	Track ft.	249,199	$1.84
Wood block	"	2,949	1.57
Brick	"	115,013	1.70
Hassam	"	65,478	1.06
Bitulithic with headers	"	16,682	1.06
Bitulithic with headers	"	700	0.98
Asphalt	"	1,952	1.06
Macadam	"	23,404	0.46
Plank	"	456	0.43
Stone block—special work	Sq. yd.	4,582	3.20
Brick—special work	"	1,245	2.55
Hassam—special work	"	913	1.70
Macadam—special work	"	352	0.78
Stone block—dummy strip	"	60	3.00
Stone block—dummy strip	Lineal ft.	6,968	1.33
Bitulithic, 9 ft.—dummy strip	"	99	0.61
Wood block—dummy strip	"	1,365	0.90
Brick—dummy strip	"	1,712	0.90
Asphalt—dummy strip	"	59,843	0.58
Macadam, 11½ ft.—dummy strip	"	567	0.30
Hassam—dummy strip	"	29,827	0.62
Bitulithic—dummy strip	"	94,355	0.62
Stone block	"	413	1.02
Macadam, 4 ft.—dummy strip	"	137	0.30
Bitulithic—dummy strip	"	1,300	0.62
Macadam—dummy strip	"	9,983	0.30
Plank—dummy strip	"	236	0.42
Concrete base	Cu. yd.	39,407	6.25
Drains, type A	Yd.	89	2.00
Drains, type B	"	69	12.00
Tile drain	Lineal ft.	459,098	0.05
Excavation for tile drain	Cu. yd.	16,986	0.75
Gravel for tile drain	"	13,760	2.00
Planking for tile drain	Ft.	229,501	15.00

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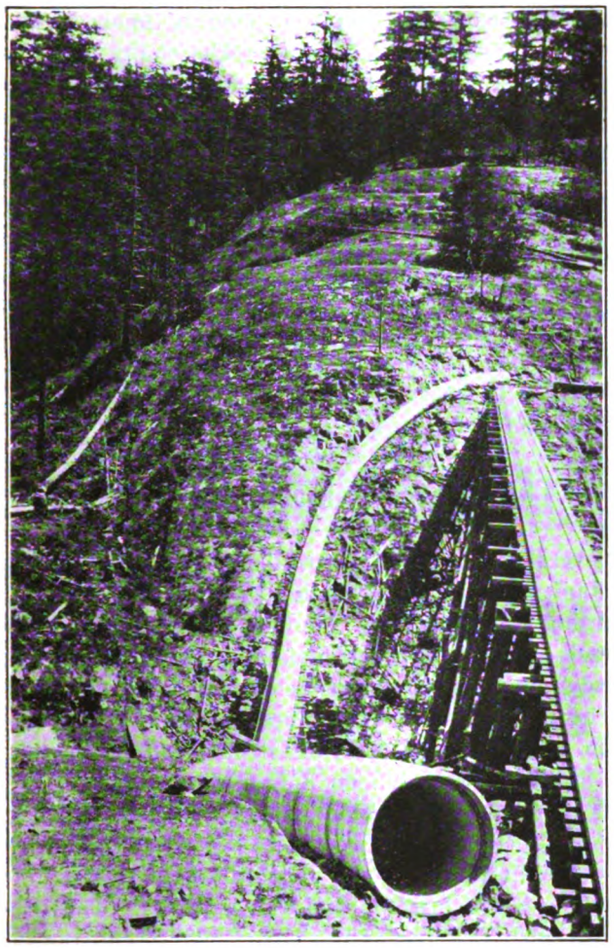
Reinforced Concrete Pipe for Sooke Water Supply*

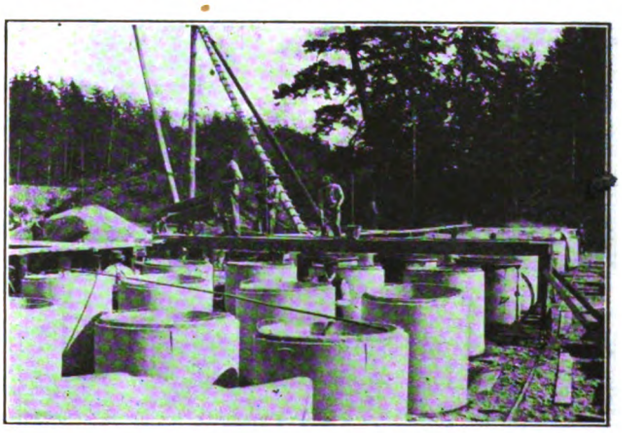


REINFORCED CONCRETE SIPHON FOR WATER-SUPPLY MAIN.

Reinforced concrete pipe has been in use for a time sufficiently long to have ceased to be a novelty. Reinforced concrete as a material for the construction of a pressure siphon, however, is a comparatively recent innovation in engineering construction. The water works department of the city of Victoria, British Columbia, has recently contracted for the construction of about 144,000 lineal feet of 42-in. diameter reinforced concrete conduit extending from Sooke lake to the Humpback pressure reservoir, which it is the purpose of this article to describe.

The cement employed was specified to be a true portland cement and subject to test according to the requirements of the American Society of Civil Engineers' standard specifications. The usual requirements that ordinarily obtain were stipulated for the sand. The gravel for the pipe ranged in size from ¼ to 1 in. Small mechanical mixers of the batch type were employed throughout. The concrete consists by volume of 1 part cement, 2 parts of sand, and 4 parts of crushed gravel. The reinforcing steel was specified to conform to the standard specifications of the American Society for Testing Materials. The pipe-line will be installed as a flow line and laid along a gradient of 1 ft. in 1000, except for such portions of the right-of-way where inverted siphons are employed to facilitate the crossing of ravines. The static head for the siphon shown in the illustration is 65 ft. Twenty-four inch diameter reinforced concrete stand-pipes are fitted to the top of the conduit and extend vertically to a point 2 ft. above the hydraulic grade line at both ends of all dips or inverted siphons. The open tops of the stand-pipes are protected by a ventilating cover having a cone-shaped top made of 3/16-in. steel plate fastened to a cylindrical screen of heavy wire, ¼-in. mesh, 24 in. diameter, and 8 in. high. The bottom edge of the screen is bolted to a band 10 in. long made of 3/16-in. plate, which is set into the end of the stand-pipe. Similar stand-pipes are placed at 2000-ft. intervals where the line is laid on the hydraulic gradient. Six-inch standard cast iron gate valves with waste connections are fitted to the bottom of all siphons in order that the discharge water may be conducted away from the conduit line and its supporting structure whenever it might be necessary.

The conduit line is not covered, but is laid on the surface upon a bench excavated along the hillside. Suitable anchorages are provided to prevent crawling and excessive movement. Expansion joints of special design will be placed at intervals along the line wherever necessary to provide for movement due to expansion or contraction. All pipes are pre-cast in a casting yard established by the contractor for the purpose. The sections are 4 ft. long and provided with steel wire mesh reinforcement, and also circumferential and longitudinal bar reinforcement for the sections that are employed for the siphons. The sections are designed with a lock joint, and the thickness of the walls is 3 in. Class A concrete is used throughout for this purpose, while a mortar consisting of one part port-



CONCRETE PIPE CURING IN STORAGE YARD.

*From data furnished by Wynn Meredith, Consulting Engineer, San Francisco.

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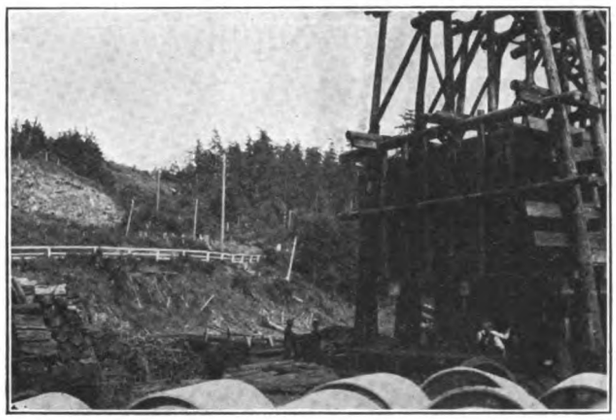

STORAGE-BIN FOR AGGREGATE.

land cement and two parts of sand is used for cementing the joints. For the forms, cast iron bottom rings and steel plates rolled to a true circle are used for the inner and outer casings. The longitudinal bars used for reinforcement project beyond the ends of the section and are so shaped as to insure interlocking with adjacent sections; 0.043 sq. in. in sectional area per foot of length of pipe wall is the minimum circular reinforcement required.

Upon removal of the forms, the pipes are covered with burlap and kept wet for six days to prevent shrink cracks due to too rapid setting. In laying the pipe, the spigot ends are pointed in the direction of the flow. After the sections are laid, a joint shield is slipped around the interior of the pipe and covering the joint space which is wholly on the interior of the pipe. Mortar is then poured and the shield left in place until the mortar has set. Contrary to the usual custom in preparing specifications for concrete pipe, these specifications did not require that the pipe should be absolutely water-tight, nor did they make use of the stock phrase 'to the satisfaction of the supervising engineer.' On the contrary, the specification states that "The pipe shall be considered tight provided the accumulated leakage at any place does not show greater than as continuous drops leaving the outside surfaces of the pipe at any point."

The maximum angle between adjacent sections is not permitted to exceed 3° at any one joint, the length of sections being varied wherever necessary to produce the required curvature. The designers of this conduit did not commit the inconsistency of laying a reinforced concrete fireproof conduit upon wooden chairs or upon wooden trestles. The chairs and trestles are also made of reinforced concrete. The chairs are pre-cast in two pieces with a piece of 1-in. gas pipe cast in, in order to provide a place for the tie bolt which draws the chairs together to a snug fit against the conduit. After drawing the chairs in place, they are grouted to make a full bearing surface. The pipe is made according to the Meriwether system by the Pacific Lock Joint Pipe Co. of Seattle and Vancouver. Wynn Meredith, of San Francisco, is consulting engineer for the water works department of the city of Victoria. The cost of the pipe laid in place is $2.29 per lineal foot.

CONCRETE MIXER EQUIPMENT.

The Motor Tank Ship 'Sebastian'

Several features of interest are presented by the oil tank steamer *Sebastian*, built by the Caledon Shipbuilding Co. at Dundee, engined by the Aktiebolaget Diesels-Motorer of Stockholm, and which sailed from London on her maiden voyage on March 2.

The two main Diesel engines have six cylinders of 16-in. diameter and 22½-in. stroke, each developing 800 hp. at 165 r.p.m., on a fuel consumption of 7½ tons of oil per day. They are of the open type, and are designed for the two-stroke cycle. Owing to the use of cylinder ports the only valves in the cylinder crown are the injector and relief valves. The overhead camshaft drives only the fuel valves and the fuel pumps. The reversing wheel and the lever controlling the admission of starting air are placed at the front of the engine with the fuel regulator and the lever which operates the relief valves.

Fresh water is employed for cooling the pistons, and is itself cooled by the incoming sea water destined for the cooling of the cylinder jackets and exhaust main. The cooling pumps are driven by the main engines. An emergency air-compressor is worked by a Diesel engine, but all the remaining auxiliaries are steam driven, a fact which explains the fitting of the funnel, which is a conspicuous feature aft. The donkey boiler is oil fired on the Meyer system, a second donkey boiler being installed for coke firing in ports where this is compulsory.

During 1913 the Chilean government repaired 415 miles of cart roads and built 58 miles of new highway, at a cost of $497,668. The four bridges under construction are to be completed during the year, and thirty-one others are under consideration at a total cost of $163,175. For 1915 it is proposed to appropriate $365,000 additional for bridges. There are now eight hundred and twenty-three bridges in Chile, which have cost $5,657,500.

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The Buckhorn Mines Company's Power Plant

By E. H. LESLIE

While the use of the locomobile type prime mover is by no means an innovation in steam power-plant engineering, having for many years been in successful operation in European countries, and Germany in particular, its advent in this country is marked with the initial installation at Beowawe, Nevada. Here two 350-hp. units are in successful operation supplying power for the Buckhorn mines and mill, the electric power generated at Beowawe being transmitted a distance of 35 miles to Buckhorn.

This type of engine, as will be seen from the illustrations, bears more semblance to a modern traction engine, which has been inverted and remodeled for stationary power purposes, than any of the standard types of American steam-engines. The surname of this type of engine, 'locomobile,' suggests its progenitor, and in fact it is an adoption of locomotive type power-plants to stationary requirements. The two Buckhorn units have a capacity of 350 hp. each. The engines are compound, the high-pressure cylinder being 11¾ in. diameter, and the low 23 in., with a 20-in. stroke, and are operated condensing.

The boiler plant upon which the engine is superimposed presents many interesting features. The boiler tubes are mounted as shown in Fig. 1, and are easily removed from the shell of the boiler and others inserted if occasion demands. The illustration shows a set of tubes which have been removed, and furnishes an idea as to the boiler construction. In the operation of the plant, the engine has been 'shut-down,' the tubes replaced, and the engine again under steam in ten hours. While this record is itself a good one, a still better record will be possible under present operating conditions, which provide for having a spare boiler readily accessible. Since the beginning of operations it has been necessary to replace one boiler. This is attributed to the fact that the boiler was used for sinking a well before the power-plant was put into commission, and in so doing it was necessary to use a boiler water which was extremely alkaline and also contained considerable oil from the pumps. Since the removal of this boiler, no further troubles have been experienced. It is hoped that a permanent supply of pure artesian water for boiler purposes will soon be obtained.

The Fire Box

The fire-box end of a unit is shown in Fig. 2. At this plant California crude oil is used for fuel, and is fed in by two injectors. The fuel oil is delivered at the plant in standard tank cars and discharged into a steel sump tank of 8000 gal. capacity, and from which it is pumped by means of a duplex 6 by 4 by 6 Platt Iron Works oil-pump to the storage tank. The storage tank is of corrugated iron and has a capacity of 50,400 gal. (5 carloads). The oil is heavy California petroleum of 16°B. In cold weather it is often necessary to heat the oil before it can be pumped. From the storage tank the oil flows by gravity to a small feed tank on the inside of the building from which it flows to the burners. There are two nozzle-injector burners for each unit. Oil and steam are admitted through the nozzle. The steam, being under a high pressure, atomizes the oil and acts as an injec-

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tor in drawing the oil from the fuel tank, heating, atomizing, and injecting it into the furnace. With the exception of the pump for raising the oil from the sump to the storage tank, the handling of the fuel oil is by gravity. Under present working conditions, the two units require about 1550 gal. of fuel oil per day, or about 1 lb. of oil per brake horse-power hour. While the engines have a capacity of 350 hp. each, under present working conditions the load is about 550 b-hp., or 275 b-hp. on each unit. With an increased load there would undoubtedly be a better fuel economy and increased thermal efficiency. The present fuel oil consumption, however, is by no means excessive, and compares most favorably with the oil-fired boiler and steam-engine combination in general use.

Engine Pumps

The boiler feed water pump and condenser pump are in tandem and on the same drive at the side of the boiler, and are driven by a belt which is connected with the main engine and generator shaft. The pumping device is most efficient, and the vacuum is kept at about 75 cm. An injector is held in reserve for boiler feed and is shown on the left of the boiler in Fig. 2. The boiler feed water heater is also shown in the same illustration. The exhaust steam from the low-pressure cylinder is drawn by the vacuum pump through the feed water heater, in which are the feed water coils. The boiler feed pump discharges the feed water through the coils, thence into the boiler.

The steam as generated passes to the steam dome and from thence to the super-heater, which is seen in Fig. 3 as the extension of the boiler proper. The steam from the dome enters at the rear of the super-heater and passes through a system of coils, which are given a super-heat by excess furnace gases. The steam then is conducted through an insulated pipe, shown in Fig. 3 from the super-heater to the engine proper.

The smoke and burned gases pass from the super-heaters through a brick-lined conduit under the engine-room floor to the stack, which is of steel and 160 ft. high. A damper for regulating the draft is placed in the brick conduit and turned by a key in the floor of the engine-room.

The steam as delivered at the high-pressure cylinder has a temperature of 720°F. In the design of this type of power-plant, every effort is made to maintain high temperatures, and toward this end super-heat, compactness of design, and thorough insulation have tended toward higher thermal efficiencies than those shown in the average boiler and steam-engine combinations. While as yet no indicator cards have been taken, and it is impossible to know either the mechanical or thermal efficiency of the plant, the load and fuel consumption are evidence of a satisfactory performance in this respect.

For synchronizing the two units of the plant a retarding device is placed on each unit, by which the

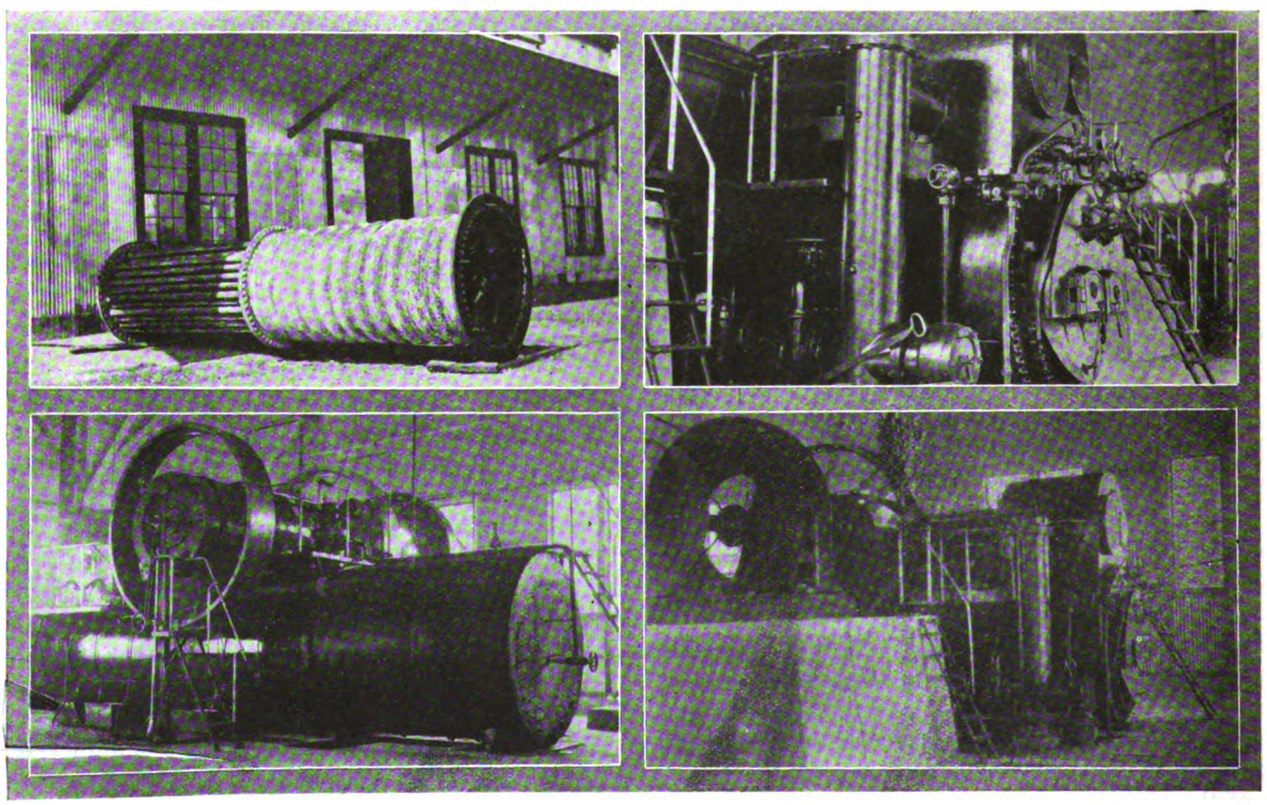

FIG. 1. BOILER TUBES.
FIG. 3. SUPER-HEATER AND SYNCHRONIZING MECHANISM.

FIG. 2. FIRE-BOX END OF ENGINE.
FIG. 4. GENERATOR.

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speed of the engine and generator, which are direct connected, may be retarded in connecting in the other unit after a 'shut-down' of one of them. This retarding device is shown in Fig. 3, being an attachment on the governor, which is within the fly-wheel as shown. The retarder is operated by a hand wheel, shown in the illustration, which acts upon the governor and in

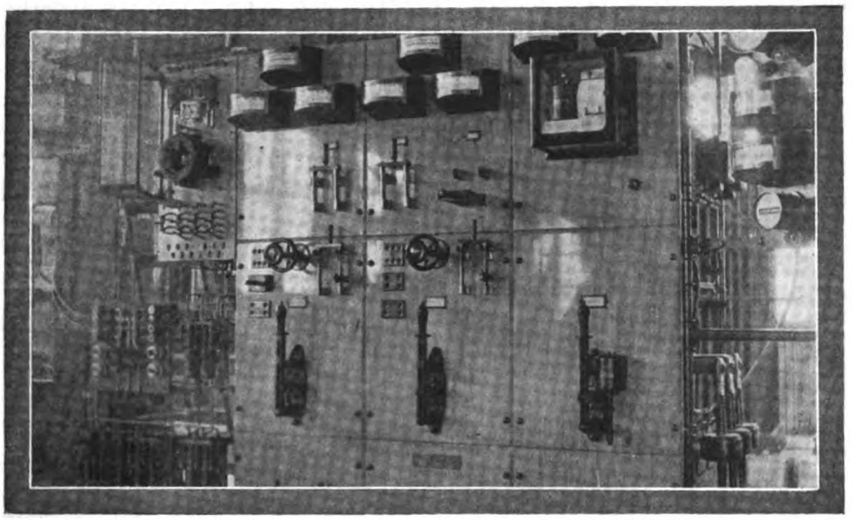

FIG. 5. SWITCH-BOARD.

turn upon the valve-rod and piston valves of the cylinders, which type of valve is used in this engine. The valve-rod has a pointer attachment which slides with the rod over a graduated scale, which has been calibrated to indicate, by measuring the travel of the pointer, the approximate horse-power which is being developed in the cylinder.

Metallic packing is used throughout the engine, and bearings are of the finest bearing alloys. The bearings are fitted with oil cups, and only the best grades of lubricating oil can be used. A careful watch must be kept on the bearings, as they are always at a temperature which will scarcely permit being touched with the hand, and a very temporary suspension in lubrication results in the burning out of a bearing, with its attendant 'shut-down' and delays. Since beginning operations there have been two bearings burned out at this plant, but with a familiarity with the engine and careful supervision, little difficulty is to be expected from this quarter. Five barrels of lubricating oil is used per month on the bearings, guides, etc.; and three barrels of cylinder oil is used per month in the cylinders of the two units. The cylinders are lubricated by means of an oil pump which is driven from the piston rod.

Over-All Dimensions

The over-all dimensions of this particular locomobile boiler and engine unit are 24 by 14 ft. 6 in. base and 10 ft. high. The engine goes under the house name of Type V.K.13, and was made by the R. Wolf Maschinenfabrik at Magdeburg, Buckau, Germany.

The engine is direct connected through a Zodel Voith flexible coupling with the generator. The coupling consists of two annular castings, one within the other, which allows an inch of play between them. These two rings are laced together by two strips of leather belting. In this manner, all of the vibration in the engine is taken up in the coupling and none is transmitted to the generator.

The generator is mounted on a large concrete block as shown in Fig. 4. The two generators were made by the General Electric Co., and are of the type A.T.B., form S, manufactured by this Company. The generators are 3-phase, 275-kw. machines, operating at 480 volts, 415 amp., and 225 r.p.m. The power factor is 0.8. The generators are excited by General Electric continuous current generator of form A, rated at 35 kw., 280 amp., 125 volts, and 850 r.p.m. The exciters are driven by a belt and pulley connection with the main generator shaft. A separate motor is about to be installed for driving the exciter. This motor is of the General Electric manufacture rated at 35 hp., 60 cycles, 46 amp., 440 volts, and 680 r.p.m.

The electrical equipment also includes four transformers, three being in use, with one extra. These transformers are General Electric apparatus, rated as type A, form B, 60 cycles, 219 kva. The current is thus stepped up from 480 to 33,000 volts for transmission to the Buckhorn mines and mill, 35 miles distant. The switchboard, shown in Fig. 5, is of gray marble fitted with a recording watt-meter, watt-hour meter, recording volt-meter, voltage regulator, together with volt and ampere meters, switches, and other equipment. There has also been installed an aluminum lightning arrester for the protection of the plant. The engine-room is also fitted with an overhead hand-operated traveling crane, for facilitating the movement of large spares and parts. The centrifugal pumps for the circulation of water through the cooling towers, seen on either side of the power-plant building, were made by the Krogh Manufacturing Co. These pumps are direct connected with small 3-hp. General Electric motors.

As a small and compact power-plant, the locomobile type at this property presents many attractive features; the fuel consumption is low, as are the attendance charges, only two men, an engineer and fireman, being required per shift of 8 hours. While exact figures are not available at this time, it may be said that efficiency of the plant compares most favorably with the regulation boiler and steam-engine combination. The super-heating and high temperatures which result from the arrangement of engine and boiler have been the cause of some mechanical difficulties, of which, however, up to the present, nothing of a serious nature has developed.

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The Reinforced Concrete Trestle Over Yolo Basin*

The California Highway Commission has undertaken a notable piece of construction across Yolo basin. The state highway crosses and runs approximately parallel to the right-of-way of the Southern Pacific Company between Davis and Sacramento, the intersection occurring a short distance beyond Webster station and joining the proposed Washington boulevard which crosses the West Sacramento irrigated farms project.

The ground traversed is lowland, which, due to its proximity to the Sacramento river, is often entirely submerged during the annual flood season. After giving careful consideration to every possible means of traversing this territory with the state highway, A. B. Fletcher, highway engineer, and his staff decided to employ reinforced concrete and timber trestles as a type of construction that would assure due resistance to the annual floods and afford a minimum expense for upkeep.

The work undertaken at the present time includes the construction of a timber trestle about 2318 ft. long and a reinforced concrete trestle about 13,851 ft. long. The pile caps for the concrete trestle will be cast in place. The floor system will be cast in units in a casting yard at one end of the trestle and erected in place, while the wheel guards will be cast in place. The concrete trestle is to be provided with an asphalt wearing surface. The structure has been so designed that it will be possible at any time to carry on the work entirely from the deck. If the structure is constructed from the deck, it is expected that the pile-driver will be fitted with four sets of leads, or with swinging leads, and that it will travel on temporary caps fitted to the permanent piles. The specifications provide that permanent caps may be cast in half lengths in order to permit the use of two of the permanent piles of each bent to support a temporary roadway. The quantity estimates made by the California Highway Commission are as follows:

1—17,080 lineal feet creosoted wooden piles driven in place.

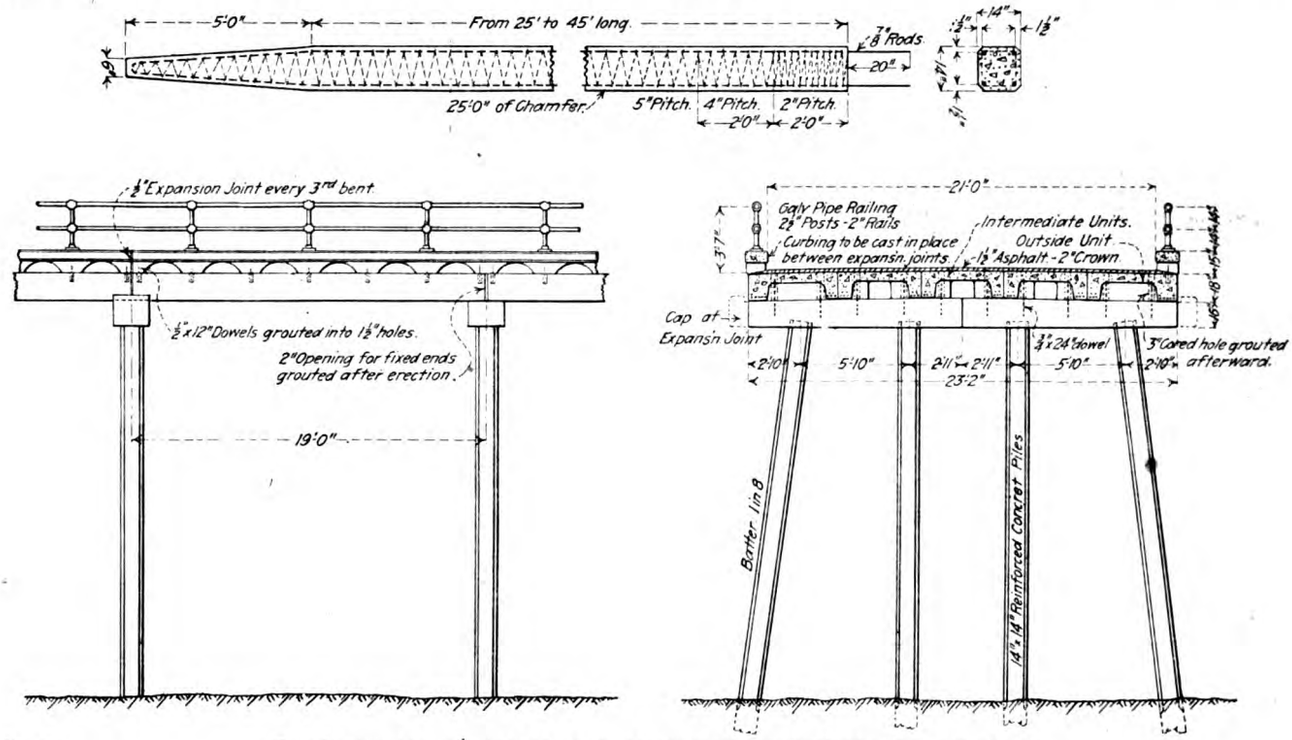

FIG. 2, SIDE AND END ELEVATION OF REINFORCED CONCRETE TRESTLE AND PILES.

2—108,500 lineal feet reinforced concrete piles driven in place.

3—550,000 ft. board measure timber (exclusive of wooden piles) in place.

4—2800 cu. yd. portland cement concrete, Class A, cast in place.

5—10,625 cu. yd. portland cement concrete, Class A, cast in yard and erected in place.

6—20 concrete monuments, making and placing.

7—27,700 lineal feet pipe rail fence, hauling and erecting.

8—32,320 sq. yd. asphalt surfacing.

Timber Trestle

Douglas yellow fir piles are specified, to be not less than 13 in. diameter at the butt and 8 in. diameter at the tip. The specification for creosoting is as follows:

*From data furnished by Austin B. Fletcher, California State Highway Engineer, Sacramento, California.

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1. It must come from works making bituminous coal gas and not water gas.

2. It must be completely liquid at 100°F., no deposit taking place above 93°F.

3. When distilled at a temperature of 600°F., there must remain from 20 to 25% of undistilled residue.

4. The creosote must contain from 6 to 10% of tar acids.

5. The creosote must contain from 18 to 24% of naphthaline.

6. The specific gravity of the creosote must be not less than 1.040 and not over 1.065.

7. During the treatment of piles the temperature of the oil bath shall not be more than 225°F.

The piles are to be injected with not less than 12 lb. of creosote per cubic foot of wood, and the penetration of the heavier black oils not less than 7/8 in. at any place in the outer surface of the pile. The piles are to be driven with a drop-hammer not less than 2000 lb., or with a steam-hammer not less than 3000 lb. Each pile to be driven until it is capable of sustaining a safe load of at least 15 tons when estimated by the following formulae:

For a pile driven with a drop-hammer: $P = \frac{2Wh}{S+1}$.

For a pile driven with a steam-hammer: $P = \frac{2Wh}{S+0.1}$.

In which P is the safe load in pounds; W, the weight of the hammer in pounds; h, the fall of the hammer in feet; and S, the penetration or sinking in inches under the last blow.

Bolts and drift pins are specified to be made of American refined iron having an elastic limit of not less than 26,000 lb. per square inch. Timber caps are 12 by 12 in. by 22 ft., and are drift bolted to the piles. Stringers are 4 by 16 in. by 20 ft., dapped, sized to uniform surface, and toenailed to the caps; 2 by 3 in. bridging is used at the centre of each span. The floor planking consists of 4 by 12 in. by 22 ft. rough timber. The type and method of construction is shown in the drawing, Fig. 2.

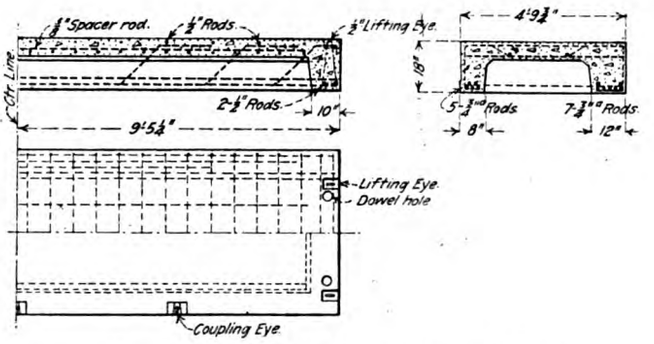

FIG. 3, REINFORCED CONCRETE FLOOR SLAB.

Concrete Trestle

The standard specifications for portland cement concrete adopted by the American Society for Testing Materials on August 16, 1909, govern the selection of cement, while the tests are to be made in accordance with the method specified in the final report of the special committee on uniform tests of cement of the American Society of Civil Engineers presented January 17, 1912. The fine aggregate is to consist of material of silicious, granitic, or igneous origin that does not carry in excess of 5% by weight of mica, nor more than 6% by weight of clay, silt, and other material passing a No. 100 screen. It shall all pass a No. 4 standard screen, and not less than 50% nor more than 85% by weight shall remain on a No. 30 screen. The coarse aggregate may be either gravel or broken stone having a specific gravity not less than 2.6 and shall range in size from 1/4 in. up to 1 1/2 in. for Class A concrete and from 1/4 in. up to 2 1/2 in. for other classes of concrete.

The aggregate is divided into three different types as follows:

Class A—1 cu. ft. portland cement, 2 cu. ft. of fine aggregate, and 4 cu. ft. of coarse aggregate.

Class B—1 cu. ft. portland cement, 2 1/2 cu. ft. fine aggregate, 5 cu. ft. of coarse aggregate.

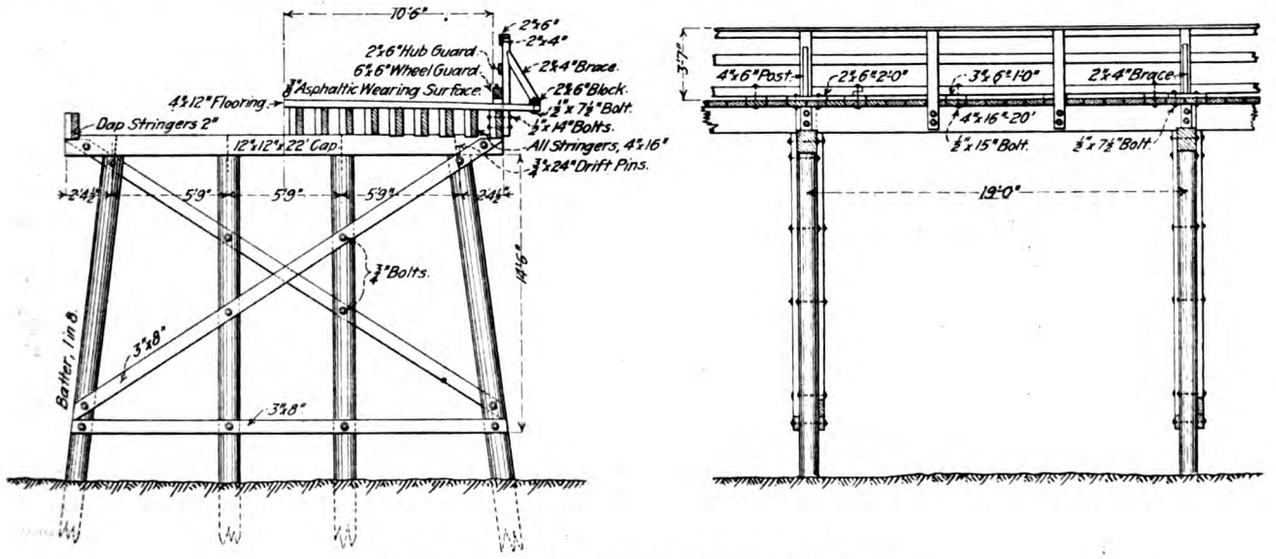

FIG. 2, SIDE AND END ELEVATION, TIMBER PILE TRESTLE.

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Class C—1 cu. ft. portland cement, 3 cu. ft. of fine aggregate, 6 cu. ft. of coarse aggregate.

The reinforced concrete piles are to be made of the Class A mixture. A period of 30 days is required for hardening before handling.

For driving, a steam-hammer is to be used weighing not less than 3000 lb. A safe load of 20 tons for each pile is required according to the same formula specified for the timber piles. The concrete caps and wheel guards are to use the Class A mixture. A period of ten days for setting is specified for the caps before floor units are placed thereon, and they are to sustain no other than the dead load until the period of 30 days for setting has elapsed. A 30-day period is also specified for the wheel guards.

The floor units are to be made of the Class A mixture. These are to be pre-cast, as mentiond before. After setting they are to be placed upon the caps and bedded in a ½-in. thick mortar made of equal parts of sand and portland cement. Dowels and other devices for fastening in place are to be used, as shown in Fig. 3. The asphalt surface shall be laid after a paint binder coat has been applied. This surface will be composed of broken stone or gravel, sandstone dust, and asphaltic cement or bituminous sand. The mixture is to be as follows:

(1) Bitumen soluble in cold carbon disulphide, between 7½ and 10%.

(2) Broken stone or gravel, sand, stone-dust, and other inorganic ingredients, as follows:

Passing a No. 200 sieve, between 8 and 13%.

Passing a No. 80 sieve, and rejected by a No. 200 sieve, between 14 and 25%.

Passing a No. 40 sieve and rejected by a No. 80 sieve, between 17 and 29%.

Passing a No. 10 sieve and rejected by a No. 40 sieve, between 5 and 11%.

Passing a No. 4 sieve and rejected by a No. 10 sieve, between 15 and 25%.

Passing a No. 2 sieve and rejected by a No. 4 sieve, between 3 and 10%.

All to pass a No. 2 sieve.

At least 8% and not more than 17% of the asphalt surface mixture shall be stone-dust.

The asphaltic cement used is specified to be a California product that will have a penetration of from 70 to 90°, District of Columbia standard. The proportion of refined solid asphalt in the asphaltic cement is to be not less than 85% by weight.

The total bitumen contained in the mixture as determined by solution in carbon disulphide shall be soluble in cold carbon tetrachloride to the extent of at least 97½%, and in petroleum naphtha of 86°B. to the extent of not less than 70% nor more than 90%. When fifty (50) grams of the mixture are heated for five hours at a uniformly maintained temperature of 325°F. in a tin box 2½ in. diameter, after the manner prescribed, it shall not lose over 0.65 of 1% in weight.

Either one of the two following methods for the preparation of the asphaltic surface may be used:

First Method—The broken stone or gravel and sand shall be heated in suitably constructed driers to a temperature between 300 and 375°F. The hot aggregate and cold stone-dust, or other fine material, shall then be thoroughly mixed together in a suitable mixer. The necessary quantity of asphaltic cement (previously heated to between 250 and 325°F.) shall then be added, and the whole mass shall be mixed in a suitable mixer for at least one minute and until a

TABULATION OF CONTRACTORS' BIDS.

Material Items and Quantities.	Estimate	Sound Const. & Eng. Co., San Francisco	Van Sant-Houghton Co., San Francisco	Graff Construction Co., Seattle, Wash.	Mahony Bros., San Francisco
Creosoted piles, driven in place, 17,080 lin. ft.	$11,956.00	$11,956.00	$13,151.60	$13,834.80	$13,664.00
Reinforced concrete piles, driven in place, 108,500 lin. ft.	70,525.00	92,225.00	84,630.00	72,695.00	86,800.00
Timber in place, 550 M ft. B. M.	17,600.00	15,125.00	19,250.00	20,900.00	17,600.00
Cement concrete, class 'A,' cast in place, 2800 cu. yd.	22,400.00	20,608.00	29,960.00	28,840.00	25,200.00
Cement concrete, class 'A,' cast in yard, erected in place, 10,625 cu. yd.	74,375.00	85,000.00	75,968.75	78,625.00	95,625.00
Monuments, 20	20.00	80.00	140.00	200.00	25.00
Pipe rail fence, hauling and erecting, 27,700 lin. ft.	1,385.00	4,155.00	1,385.00	3,601.00	1,592.75
Asphalt surface, 32,320 sq. yd.	17,726.50	16,160.00	19,392.00	21,008.00	20,361.60
Net total	$215,987.50				
Contingencies, 15%	32,398.13				
Totals	$248,385.63	$245,309.00	$243,877.35	$239.703.80	$260,868.35

Materials furnished by state: pipe rail fencing, reinforcing steel, portland cement, coarse and fine aggregate, $148,166.06.

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thoroughly homogeneous mixture is thereby obtained.

Second Method—The broken stone or gravel, sand, and stone-dust shall be introduced together into a rotary heating and mixing apparatus and heated to a temperature of between 250 and 325°F. While being mixed, the necessary quantity of asphaltic cement shall then be introduced into heating and mixing apparatus with the other materials, and the whole mass brought to a temperature of between 250 and 325°F. The cooking and mixing operation shall continue for at least 10 minutes at such temperature.

In either of the above instances, the process of mixing shall be continued until every particle of sand and stone-dust is thoroughly coated with a thin layer of asphaltic cement.

In no case, after refined, shall the asphaltic cement be heated above 350°F.

The surface mixture, prepared as above, shall be brought to the work in suitable carts or dump-wagons provided with a canvas or other suitable cover. It shall leave the plant at a temperature between 275 and 325°F., and shall be placed in the pavement at a minimum temperature of 275°F. It shall be dumped at such distance from the work that all of the mixture must be turned and distributed to the place where it is to be raked. It shall be spread while hot, to such depth upon the concrete floor that after receiving its ultimate compression by rolling it shall have an average thickness of 1½ inches.

It shall be immediately compressed by a hot hand-roller, and, when sufficiently cool, be thoroughly compressed by a roller weighing not more than 125 lb. to the linear inch width of tire, after which a small amount of portland cement or infusorial earth shall be swept over it. It will then immediately be thoroughly rolled by a roller weighing not less than 210 lb. to the linear inch width of tire. The rolling must be continued for not less than 5 hours for every 1000 sq. yd. of pavement.

All places that are inaccessible to the roller must be tamped with hot iron tampers.

The resulting pavement must show a close grain, even, and smooth surface, true to grade and cross-section, and free from all hollows or inequalities. When a straight-edge 5 ft. long is laid on the finished surface of the roadway, and parallel with the line of the road, the surface shall in no place vary more than ¼ in. from the lower edge of the straight-edge.

Causes of Collapsed Well Casing

By DORSEY HAGER*

There has been much trouble with casing collapsing in California oil wells. A number of theories explaining collapses have been presented, some of which are good, others not so reasonable.

Casing collapses are thought due to the following conditions:

1. Water pressures.
2. Cave-ins due to withdrawal of sand.
3. Gas pressures.
4. Lateral shifting of sand.
5. Heaving of sands and shales.
6. Earthquakes.

Numbers 1, 2 and 3 are well recognized causes of casing collapses. Numbers 4, 5, and 6 are but secondary phenomena, and are not in themselves the cause of casing collapses. Unbalanced rock pressure due to gravitative influence is the cause back of 4, 5, and 6 and possibly 3. To this unbalanced rock pressure the writer ascribes a large portion of collapsed casing troubles.

Water Pressures.—Water pressure is the cause of much trouble especially where there is sufficient head to exert a severe inward pressure on the casing. A column of water 1000 ft. high exerts a weight of 434 lb. per square inch. This pressure unbalanced is not dangerous in most cases. However, where the pressure is doubled or trebled to 1000 or to 1500 lb. per sq. in., the water may occasion a great deal of trouble if sufficiently strong casing is not used to offset the pressure.

Mr. R. S. Haseltine presented a paper 'Collapsing Pressure of Steel Tubes' before the Coalinga Oil Men's Association, March 16, 1911,† which gives an excellent discussion and summary of water pressures and casing collapses. The table, which is reprinted here, dealing with the collapsing pressures of casing is very valuable and instructive. Further reference will be made to this paper.

Cave-Ins.—In many pumping and flowing wells, great quantities of sand are withdrawn from the oil strata. This withdrawn sand leaves a space of minimum density around the casings and also leaves the soft shale roofs found in so many California wells, unsupported. This roof falls, and collapses the casing. The writer treated this subject in detail in the *Mining and Scientific Press*, August 5, 1911, and refers to that discussion for further details.

Gas Pressure.—Gas pressure may cause the collapse of casing, where gas pressures of 500 to 1000 lb. per sq. in. are encountered as is the case in some of the great gushers. Such heavy pressures are not common, however, and when they do occur, what is the cause?

Lateral Shifting of Sands.—Shifting sands are variously reported as having caused casing collapses or broken off pipe. Lateral shifting of casing has been

*Geological Engineer, Title Insurance Bdg., Los Angeles, Cal.

†*Western Engineering*, July 1912.

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TABLE SHOWING COLLAPSING PRESSURES OF LAP-WELDED STEEL CASING FOR SIZES COMMONLY USED IN CALIFORNIA.

Size, in.	Weight per Foot, lb.	Inside Diameter, in.	Outside Diameter, in.	Thickness, in.	Collapsing Pressure, lb. per sq. in.	Equivalent Water Column, ft.	Water Column, Factor of Safety 2, ft.
4½	15.0	4.500	5.000	0.250	2944	6790	3395
5⅝	20.0	5.370	6.000	0.315	3160	7280	3640
6¼	20.0	6.000	6.625	0.312	2704	6230	3115
	26.0	5.845	6.625	0.390	3717	8560	4280
	28.0	5.775	6.625	0.425	4167	9600	4800
6⅝	20.0	6.437	7.000	0.281	2096	4830	2415
	26.0	6.312	7.000	0.344	2867	6600	3300
	28.0	6.220	7.000	0.390	3440	7930	3965
7⅝	26.0	7.390	8.000	0.305	1914	4410	2205
8¼	28.0	8.015	8.625	0.305	1680	3870	1935
	32.0	7.935	8.625	0.345	2080	4790	2395
	36.0	7.875	8.625	0.375	2383	5490	2745
	38.0	7.765	8.625	0.430	2928	6750	3375
	43.0	7.625	8.625	0.500	3638	8380	4190
9⅝	33.0	9.500	10,000	0.250	780	1800	900
10	40.0	10.000	10.750	0.375	1638	3770	1885
	48.0	9.850	10.750	0.450	2234	5150	2575
	54.0	9.750	10.750	0.500	2643	6090	3045
11⅝	40.0	11.437	12.000	0.281	641	1475	737
12½	40.0	12.500	13.000	0.250	402	927	463
	45.0	12.360	13.000	0.320	745	1717	858
	50.0	12.250	13.000	0.375	1109	2560	1280
13½	50.0	13.250	14.000	0.375	936	2160	1080
15½	51.3	15.416	16.000	0.292	314	724	362

TABLE I.

noted in a number of cases. To say that shifting sands is the cause, does not go back to the prime motive. Lateral shifting is the result of some one cause. What is it?

Heaving Formations.—Heaving sands and shales are considered to collapse some casing. The sudden release of pressure in the drill hole allows the shales and sands to rush, or tend to rush into the drill hole, and collapse weak casing. What causes this heaving?

Earthquakes.—Earthquakes are thought to cause casing troubles. Earthquakes are supposedly the result of the slipping of strata one upon another, due to compression or tension. Faulting as the result of slipping may accompany earthquakes. In some cases, well casings may be affected. Many such phenomena are due probably to mountain making causes. However, local slips may result from another cause.

The first three theories are in themselves primal causes of casing collapse, but the latter three causes cannot be called primary and, as before stated, fall under another cause which the writer feels is due to rock pressure, or to be exact, the lateral resultant of unbalanced rock pressure on folded structures. The following discussion outlines the theory.

Compression Due to Rock Pressure.—The theory in brief is as follows: Where the earth's strata are thrown into folds, these folds are under compression due to gravitative influence or due to the weight of the overlying formations. Some strata can resist less than others and are more subject to movements than others. Thus soft sands and shales are more subject to change due to compressive action than are sandstones and limestones. Shales and sands creep, shift or heave under compressive power that would not noticeably affect the harder formations.

Folds furnish excellent conditions for unbalanced pressures and consequently, when drill holes which disturb the equilibrium of a series of pressures are put down, collapsing of the casing or caving of the open hole results.

Consider the fold shown in Fig. 1. At any point the

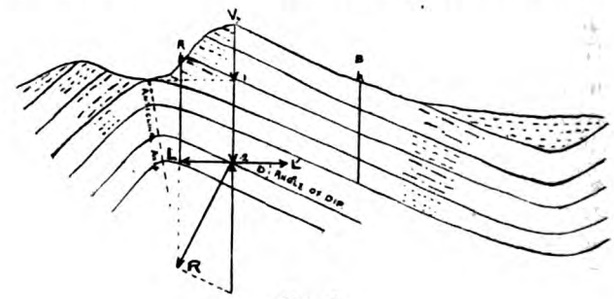

FIG. 1.

vertical pressure of the strata may be resolved into a component at right angles to the dip of the strata. This component R can be resolved into a resultant L, which we will call the lateral pressure. It is the action of this lateral pressure which the writer believes explains casing troubles more fully than any other theory. The resultant toward the syncline compresses casing in holes drilled down the dip from the outcroppings of oil strata.

Such in brief is the theory. A few tentative conclusions are presented for discussion:

By trigonometry the resultant compressive power L is given by the following expression:

L = cos angle of dip × cos 90 − angle of dip W.

(W is the weight of overlying strata.)

Theoretically this pressure is greatest when the angle of dip is 45°, decreasing when the angle decreases or increases above 45°.

Measure of Pressure.—Suppose a thickness of strata of 3000 ft. composed of clays, shales, conglomerates, sands, and sandstones. The average specific gravity of such strata is 2.5. That is, 1 cu. ft. of such material weighs 2½ times the weight of a cubic foot of water under atmospheric pressure and at 60°F.

Water weighs 62.5 lb. per cubic foot. Then 1 cu. ft. of the above materials will weigh $62.5 \times 2.5 = 156 +$ lbs.

A column of stone 1 ft. high and 1 sq. in. at the base will exert a pressure $\frac{156}{144} = 1.08$ lb. per square inch.

A column of strata 3000 ft. thick will exert a pressure of $1.08 \times 3000 = 3240$ lb. per square inch.

The lateral resultant of this for an angle of dip of

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45° will be $L = \cos 45 \times (\cos 90 - 45) \times 3240$; or $0.5 \times 3240 = 1620$.

For an angle of dip of 30° $L = \cos 30 \times \cos \frac{(90-30)}{60} \times 3240 = 0.866 \times 0.5 \times 3240 = 1403$.

Likewise for 60° dip $L = \cos 60 \times \cos \frac{(90-60)}{30} \times 3240 = 0.5 \times 0.866 \times 3240 = 1403$.

Such high pressures are certainly great enough to cause casing collapses in weak or defective casings. Even at a few hundred feet, pressures of 300 to 400 lbs. may cause the formations to cave or to creep into the drill hole.

The deeper the hole is carried, the greater the pressures and the greater the need for heavy casing. Table I gives some casings tests. Note that the larger the casing and the less the weight, the less resistance it offers to compression. In all engineering work it is usual to use factors of safety to insure sufficient strength to make up for any weakness in iron, steel, stone, or other materials due to flaws in the material. Such factors in oilfield work are 2 and 3. A factor of safety of 2 means that a casing has twice the resistive strength necessary to offset collapsing pressures. A 12½-in. casing weighing 40 lb. per foot would withstand but 402 lb. lateral compression.

However, a weak place in the casing might fall below that limit to one-half of the normal strength. Then if pressures of 300 to 500 lbs. are exerted, the casing may collapse. The remedy here is simply to use a casing sufficiently heavy to have a factor of safety of 2 or 3 if possible and to use only good casing.

An 8¼-in. 28-lb. casing has a collapsing pressure of 1680 lb. A lateral rock pressure of 1000 lb. may readily be obtained at a depth of 2000 to 2500 ft. The factor of safety here is but 1.68, so that any weakness in pipe would lower the compressive resistance to a very dangerous point.

So far nothing has been said about drilling water in a test hole or oil in a pumping well. Of course where the hole is full of water, each 1000 ft. of water exerts a pressure of 434 lb. inside the casing. This pressure will about balance the lateral rock pressure. But where the well is bailed or pumped down, danger threatens.

Further Notes.—From the lateral rock pressures computed above, one also can readily appreciate why formations tend to bulge, creep, or shift into drill holes. The less consolidated the material, the more subject it is to the pressures. The ability to resist such deformative forces lies in the cementation of sand grains, their interlocking and perhaps adhesion of the grains where there is no cementing material between the grains and the spaces are filled with water or oil, the resistance is small.

One can also readily understand why it is that Pennsylvania, Illinois, Louisiana, Oklahoma, and Texas holes have comparatively little casing trouble. Even where the formations made up of unconsolidated materials, the pressures on almost flat structures would be much less than on the more inclined structures of California. However, it so happens in most of the Eastern fields that the formations are much older than in California and compacted to a much greater extent.

Different California fields vary in that respect, however, the older formations in Ventura county (the Sespe and Topalapa) standing up without casing to considerable depths when drilled 'dry,' that is, with only enough water to keep the tools free. • Again the same forces that caused folding are at work at present. Such being true, there are compressive forces other than gravity. However, one can approximate the gravitative pressure but not the orogenic (mountain-forming) pressure.

It is stated that the great gas pressures are due to its expansive force. To expand, however, the gas must first be compressed, and the above theory will account for compression, it is believed.

Conclusion.—The theory as outlined above is open for discussion and criticism, which the writer invites. As yet the writer has seen no papers along the above lines, and before fully accepting this theory, feels that further discussion is desirable.

East Asiatic Company's Motor Ships

The following is an extract from the report of the East Asiatic Co., Ltd., for the year ended December 31, 1913, and indicates the satisfactory nature of the operation of the various motor ships owned by the firm.

"The Company's motor ships have worked satisfactorily in every respect, amply fulfilling the hopes expressed in the appendix to the two last yearly reports, and they have realized considerably larger net profit, as compared with the steamers. As regards the conversions and new constructions mentioned in the report for 1912, it is expected that Diesel motors will be installed in April, May, and June, in the steamers *Bandon*, *Champon*, and *Pangan* respectively, the steam engines from these vessels being fitted into the *Transvaal*, *Rhodesia*, and *Natal*, which are expected to be completed in March, May, and June. The motor ships *Fionia*, *Falstria*, *Lalandia*, *Malakka*, and *Tongking* are expected to be ready for service in March, May, June, August, and September, respectively.

"In view of the success of Diesel motors, the Company has decided to build a sailing ship of a little over 5000 tons dead weight, and also fitted with an auxiliary screw, driven by a 600-hp. Diesel motor.

The following is a list of the Company's motor vessels on order:

Name.	Tons gross reg., about	Tons D.W., about	I.H.P.
M.s. *Malakka*	5500	10,000	3300
M.s. *Tongking*	5500	10,000	3300
M.s. *Fionia*	5000	7,000	4100
M.s. *Falstria*	4500	7,000	2500
M.s. *Lalandia*	4500	7,000	2500
Sailing ship with Diesel motor	5,000		600

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The Manager of an Irrigation Project

By F. H. NEWELL*

The engineer who has taken the position of a manager of a great irrigation work has a class of problems quite distinct from those connected with the building of the work. Primarily his chief concern is with the water users, but there are certain physical conditions which must be fully considered by him. In the following paragraph a review is given of some of these which must be studied and taken into account.

Environment.—The manager finds certain works more or less completed, with location fixed and with a population of water users or customers provided. He does not have a free hand in planning and locating the works nor in radically modifying them to suit his ideals. He must take what he finds and adapt his methods largely to the physical conditions. For this reason, it is of the highest importance that he have a full knowledge and accurate records at hand, not depending upon hearsay or assumptions as to the facts of water supply, climate, soil conditions, and related natural phenomena; he should endeavor to keep up such observations as will increase his knowledge of the environment.

Restrictions.—The methods of operation which are suitable to an irrigation system, for example, in southern Arizona, where water is delivered throughout the year, would obviously not be applicable in Montana, where the crop season is short and where the extreme cold materially affects the stability of hydraulic structures. While there are certain broad principles which can be applied under all known conditions, yet the practical application of these must be controlled from time to time in accordance with the knowledge of limiting conditions acquired by observation and experience.

The principal limitations are those of water supply, climate, and soil conditions. The water supply is perhaps the most important, as the methods of management must be adapted to the amount of water available. For example, even though the irrigation season may be so long that with ample water two or more crops might be raised each year, yet with restricted supply, it is necessary to concentrate all efforts on using this supply in the most advantageous way during the period when it occurs.

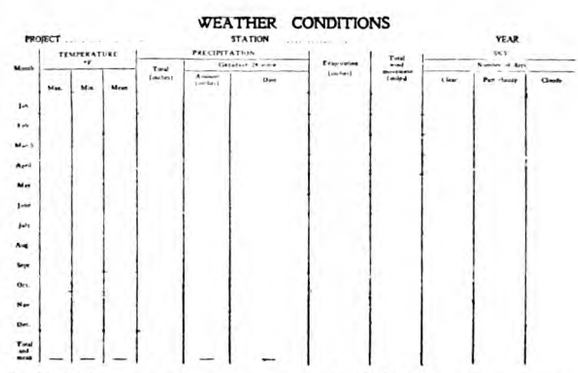
With higher development, it may be possible to regulate the water supply by means of reservoirs, so as to insure a certain amount for use at any desired time. In few instances, however, is it possible completely to regulate the supply. Usually there will be, in some part of the year or during an occasional year, a surplus which may be used to advantage for a quick annual crop. Thus, the ideal scheme which could be laid out under the assumption that water can be had whenever needed must be modified to produce the most effective results with fluctuating quantity.

Climate.—The climatic conditions of any locality may be regarded as fixed within a certain range. Observations continued throughout a period of half a century, show that there is little, if any, progressive change but that the average temperature, precipitation, wind movement, and other phenomena for any half century are practically the same as that of an equivalent time preceding or succeeding this period.

The difficulties which the irrigation manager encounters in climate, however, are those which arise from lack of knowledge as to what are the fixed limits within which these climatic factors vary. Throughout the greater part of the arid region the land has been settled for so short a time that there are no reliable results based on continuous observations within the particular area with which he is concerned. Usually, he can obtain the facts for four or five years but these years for which data are had may be exceptional as regards either heat or cold, drought or storm. They may tend to mislead the manager rather than assist. However, he must utilize such facts as he can obtain and supplement these from day to day by records which will serve as a guidance in the future.

In particular, there should be maintained observations of rain and snow fall at certain permanent points such as at the principal diversion dams and at or near canal riders' houses in the irrigated lands. Also there should be had observations of temperature to ascertain the warm or cold spots on the project and the time of occurrence of early and late frosts within the cultivated area. There are certain localities in each large irrigated district which are particularly favored in regard to temperature and the effective distribution of water is modified by the ability of these areas to produce certain classes of crops.

The following form has been found to be convenient


WEATHER CONDITIONS

PROJECT ..... STATION ..... YEAR .....

Month	Temperature °F			Precipitation			Evaporation (inches)	Total wind movement (miles)	Sky		
	Max.	Min.	Mean	Total (inches)	Greatest 24 hours				Number of days		
					Amount (inches)	Date			Clear	Part cloudy	Cloudy
Jan.											
Feb.											
March											
April											
May											
June											
July											
Aug.											
Sept.											
Oct.											
Nov.											
Dec.											
Total for year	—	—	—		—	—					

Dates of last killing frost in spring ..... of first killing frost in fall .....

Dates of serious rainfall ..... of hail storms ..... of wind storms .....

Remarks .....

*Director U. S. Reclamation Service, Washington, D. C.

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for keeping such records, being much simplified from those prepared by the Weather Bureau. In cases where the Weather Bureau records are kept on a project the data from these should be had by the manager, but these usually pertain to only one point. They should be supplemented by simple records kept at various points within the agricultural area, as above noted, and also as far as practicable at the reservoir dams or other points accessible in the mountains.

Soil.—The character and condition of the soil, while vital to the success of agriculture is relatively of less importance in the success of an irrigation project than are some of the other physical limitations, such as proper location of the works and favorable climate. This is because of the fact that throughout the arid region the soils as a rule, while deficient in humus, are of such character than even at first with proper treatment they will produce fair grain crops, such as barley or wheat. Later, with careful handling, they can be brought up to the high degree of fertility. As a rule, they have not been leached of the valuable mineral salts to the same degree as the soils of the humid region. They contain considerable quantities of soluble minerals of some value to plant life. With adequate supply of water and favorable climatic conditions, the ordinary soils can usually be depended upon from the outset to produce remunerative crops.

The fact that there are certain soluble salts in the soil is not only a source of profit but also of danger in that, by careless handling of the water, these salts may be washed out from one portion of the field and concentrated in another, producing what is commonly known as alkali, destructive to valuable plant life. With indifferent handling of the water, therefore, not only is the soil value greatly reduced but large areas of otherwise fertile soil are more or less permanently injured and can be relieved only by an effective system of drains.

The soil of the arid region, as above noted, is usually deficient in humus or nitrogenous matter; one of the first and greatest problems of the irrigation manager on a new project is to induce the irrigators to cultivate crops such as alfalfa and peas which will put nitrogen in the soil, and to bring about an appreciation on the part of the farmers of the desirability of plowing under some of these crops in order to maintain or increase the soil fertility.

An unfortunate fallacy has prevailed throughout the country to the effect that irrigated land needs little or no artificial fertilizer. This has been based on erroneous statements regarding the fertility of irrigated lands of Egypt, where it has been alleged that for centuries certain fields have been irrigated and cultivated, depending wholly upon the muddy waters of the Nile. As a matter of fact, however, the men who have cultivated these fields for generations have applied fertilizer as far as lay within their power; one of the great problems now concerning the agriculturists of the valley of the Nile and other similar irrigated regions is to obtain sufficient potash and other ingredients needed to keep up the crop yield.

Water Supply.—Under few, if any, irrigation systems, even where storage reservoirs are provided, is there complete or reliable information concerning the fluctuations of water supply. Each year occurs a new combination of conditions and new problems regarding the handling of the water available. Either the floods come very early or late, or are exceptionally large, or small; the average year never occurs. Thus, the manager, to have a basis for his judgment, must continually observe and record the daily changing conditions of water supply and compare these with what has happened during previous years. In this way alone can he plan effectively to use the water available.

An irrigation system usually is developed to a point where all of the ordinary water supply is needed. Then it becomes a matter of skill and judgment to determine to what extent cultivation of additional fields may be justified by the probability of obtaining more water, or at more favorable time than in some preceding year.

Comparison of Systems.—In order to make comparison of irrigation systems, it is necessary to classify them in a general way; that is to say, the figures showing expenditures, for example, for operation and maintenance of a system provided with reservoirs cannot well be compared with those for another system without reservoirs. In order to enable such comparison to be made, it is desirable to classify expenditures for the different parts of a system, namely, for the storage or diversion of water, for its carriage, for distribution to the field, and for drainage. By this means the cost of a small system which consists essentially of distributing canals may be compared with the similar cost of operating and maintaining an approximately equal area or portion of the distributing system of a large canal, since this process eliminates from the comparison the cost of reservoirs and related expenditures not encountered in the case of the small canal.

Structural Restrictions.—Many irrigation systems have been planned and built by men who have had little or no experience in the practical problems of operation and maintenance. This is due to the fact that the management of irrigation systems is relatively a new art, in which the fundamental principles have hardly yet been recognized or agreed upon. Most of the systems after construction have been handled for a time by some one or another of the men connected with their construction, or turned over to local associations who have shifted the management from year to year with little continuity of plan or personnel. Thus, it happens that the man or men who may have acquired valuable experience in the practical details of managing the canal system have drifted off into other occupations.

As a result of the fact that the experience had in handling one canal system has rarely been used in

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constructing another, it is found that when the new system has been built and is being put into operation, there are many limitations which have been imposed by construction and which can be removed, if at all, only in part and quite slowly. For example, many of the structures may have been built with the assumption that a small, steady flow of water would be used, whereas after some years of experimentation it may be found that greater efficiency could be obtained by using large heads or runs, but that this is prevented by certain flumes or gates being too small to accommodate these large heads. In the course of time some of these structures can be replaced and the system gradually improved. The danger is that in the meantime the water users may have become fixed in poor practices.

The irrigation manager thus has a continual problem before him of ascertaining what are the best methods and in studying how far he can put these methods into practice with the limitations which have been imposed by the men who preceded him in building the system. He can rarely make radical changes but must lay out a systematic course of procedure and gradually adjust the methods and works to these.

Location of Canal.—The principal restriction is that imposed by the main canal. It can carry only a certain amount of water and if there is ample supply in the river the question of development of the project rests at first on the capacity of this canal and of its structures. The location, however, may limit the area of land which can be covered by gravity, for if all of the land which lies below the canal is irrigated, then any extension of the system must presumably be made by pumping to a slightly higher ground not commanded by the gravity flow.

Whether or not more land can be brought under irrigation by enlarging or extending the system, it is the duty of the manager at all times to endeavor to attain the highest efficiency and economy. This can be done only when all of the land which can be irrigated is put to its highest use. For one reason, the overhead charges are usually fixed, whether the area irrigated is larger or smaller or the crop production greater or less, thus every additional acre of land which can be served tends to reduce the proportionate cost per acre to the irrigator. While there are these limitations imposed by the original size and location of the main canal, it is usually possible to increase the effective area by careful study of surrounding conditions, particularly as to the practicability of pumping water at drops in the main canal, and of distributing it more completely to the lands within the reach of gravity.

In reviewing the physical conditions and limitations which are imposed upon the manager of any large irrigation work, it is appreciated that from the physical standpoint he does not have the breadth of opportunity in molding and shaping conditions as had his brother engineer who is building similar works. Nevertheless, although these physical limitations do set relatively narrow bounds, there is opportunity for the exercise of the engineering skill, judgment and ability in dealing with the problems of making the works serve their highest purposes in bringing water to the land at the right time and in the quantities needed by the soil. There is always opportunity for the exercise of ingenuity in fitting the canal structures more closely to the limitations. The continual study of these problems yields many interesting facts, some of which previously had been overlooked or which have developed as more complete knowledge is had of the climate, soil, and water supply.

The Bureau of Mines Exhibit at the Panama-Pacific Exposition

The United States Bureau of Mines is planning a comprehensive exhibit at the Panama-Pacific Exposition.

In arranging the exhibit, the Bureau has had in mind, not only the value of interesting those engaged in the various mining and metallurgical industries, but also the education of the general public to a better knowledge of the magnitude of these industries and to the efforts which are honestly being made by the miners and mine operators, with the assistance of the Bureau of Mines, looking toward a more safe conduct of mining and a more efficient utilization of the products of the mines after they are won from the earth.

The Bureau's exhibit is located in the Palace of Mines and Metallurgy. An automatic duplex projecting machine will continuously show lantern slides illustrative of the activities of the Bureau and simultaneously give descriptions of the lantern slides.

Nearby will be shown the layout of a model hospital, including a receiving room, ward room, and operating room, fully equipped for demonstrations by the United States Marine Hospital Service; also a model of a change and wash house, another welfare feature which is being installed at modern mining and metallurgical operations. A plan of an ideal mining town will be shown.

First-aid demonstrations will be given frequently. An air of reality will be lent to the demonstration by the removal of apparently injured men from the exhibition mine beneath the building by helmet and rescue crews.

A complete display of rescue apparatus and safety lamps will be given in a glass smoke-room. Tests of safety lamps will be made, showing their tendency, under unfavorable conditions, to ignite explosive gas, and also showing methods of testing for explosive gas by means of their caps. An exhibit of the physical and chemical characteristics and constituents of explosives is being arranged.

Visitors going through the exhibition mine will regain the surface through the radium booth in which actual radium emanations will be shown.

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Richmond, California, Municipal Water Supply Cost Estimates*

General estimates are given for the cost of developing the project to its ultimate capacity of 12,000,000 gal. per day, first, with water supplied by surface runoff from the San Pablo creek, and second, with water pumped from the Sacramento river.

The first item is exclusive of the cost of land for the San Pablo reservoir and watershed, a matter so problematical that the writers do not feel justified in making any cost estimates.

It is not necessary to develop the system to its ultimate capacity at present. Six million gallons per day will suffice for a number of years. Accordingly, estimates are finally given for the cost of developing the recommended Sacramento river supply so that it will furnish immediately 6,000,000 gal. per day. Portions which are inconvenient or expensive to enlarge should have their ultimate capacity when first installed. Other important portions, however, can be gradually enlarged as the increasing consumption warrants. This last group of estimates for a water supply developed from the Sacramento river with the present capacity of 6,000,000 gal. per day is the only one of immediate interest, and is the one upon which the present bond issue should be based.

The cost of completing the development of the proposed system is important in judging of the general merit of the scheme and in predicting probable future water rates. As the city grows, until the 12,000,000 gal. per day capacity is inadequate, further enlargement, addition or renewals will be continuously made. One of the great advantages of the recommended source of supply is that there will always be sufficient water to enable the required additional supply to be obtained from this same source. A study of the surface runoff of the San Pablo and Pinole Creek watersheds was necessary before intelligent conclusions could be reached regarding the source most suitable from all standpoints. Preliminary investigations indicate that no other primary sources of supply have sufficient merit to warrant a detailed investigation of the costs.

The cost estimates will be given under the three following general segregations, or groups:

Group A—12,000,000 gal. per day, ultimate project to develop and distribute water from surface runoff.

Group B—12,000,000 gal. per day, ultimate project to develop and distribute water from the Sacramento and San Joaquin rivers.

Group C—Present 6,000,000 gal. per day project, to develop and distribute water from the Sacramento and San Joaquin rivers.

Unit Prices

The unit prices used in the following estimates are based on prices quoted in the fall of 1913 by local manufacturers. These are believed to be quite conservative throughout. As it is the universal experience that in large projects of this nature many unforeseen contingencies arise during construction work, a general addition of 10% has been made to each item to cover such contingencies. Many of the items, especially those not intended for immediate construction, have not been designed in detail and hence the cost estimates are quite general.

Pipe-Line

This is by far the largest single item of cost. Alternate estimates have been made for the use of wood stave, riveted steel, and cast iron pipe. Estimates in all cases are based on the use of first-class construction throughout, with ample safety for the heads involved, and with the best possible preservative coatings to insure the longest life practicable to obtain. All pipe, except for short trestles, is to be buried underground in order to protect it from injury, to prolong its life, and to keep the water cool. On the peat lands of Sherman island, the pipe will probably be buried for one-half of its depth, and covered with the material excavated from the trench.

Wood Stave Pipe

The estimate on wood stave pipe is based on the prices quoted by local manufacturers for pipe built in the trench, but not including hauling, trenching, and backfilling. A flat charge of $2 per ton for hauling materials from the cars to the site of the work, and $1 per lineal foot for trenching and backfilling was used.

Riveted Steel Pipe

The estimated cost of the riveted steel pipe is based on local quotations for pipe, to which has been added a flat charge of $4 per ton for hauling to the site of the work, and $1 per lineal foot for trenching and backfilling, and 75c. per lineal foot for laying and connecting the joints.

Cast Iron Pipe

The estimate for cast iron pipe is based on a cost of $32 per ton f.o.b. Richmond, for the pipe, to which has been added a cost of $4 per ton for switching local freight, handling, and hauling to the work, $1 per lineal foot for trenching and backfilling and 25c. per foot for laying and connecting the joints. A high figure was used for handling and hauling, because of the great weight of the 12-ft. lengths of pipe. This weight ranges from 2⅓ to 3¼ tons per piece. It was assumed that special equipment would be required to load and unload these pieces.

Filter Plants

The cost of the filters is estimated from a careful study of the cost of similar works, and by making proper allowance for the effect of local conditions.

*From report by Haviland, Dozier & Tibbets, San Francisco.

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Pumping Plants

The cost estimates for the pumping plants have been based on the use of first-class construction throughout, with heavy concrete foundations, and reinforced concrete superstructures. As the buildings for the pumping plants and filters will be about the only opportunity for structures of esthetic appearance it is believed that the architectural merit of the plant should be carefully considered, even though a slight additional expense is involved.

Tunnel

If the alternate location for the conduit from Martinez to Pinole is used, involving a 15,000-ft. tunnel, this will undoubtedly prove the slowest portion of the work, and hence to expedite its construction as much as possible, estimates have been based on the construction of two shafts, about 300 ft. in depth, so that work could proceed simultaneously from six headings. About two-thirds of the material excavated would then have to be raised this extra 300 ft., materially increasing the unit cost, but enabling the tunnel to be completed within a period of 8 to 12 months.

Rights of Way

This is always one of the most difficult items to estimate. Unit figures have been used which are much above the average value of the land. Much of the conduit will be located along county roads, where it is assumed that the rights of way can be obtained at nominal cost. Liberal figures have been allowed for land to be acquired for reservoirs, especially in the urban section of the city of Richmond.

Group A—12 Million Gallons per Day Ultimate Project to Develop and Distribute Water from Surface Runoff.

A-1—San Pablo Dam and Reservoir

Earth dam, 132 ft. high, with corewall	$ 837,750
Inlet tower and accessories	31,350
Outlet tunnel	18,000
Pipe outlet, valves, etc.	8,500
Spillway, wasteway, etc.	8,750
	$ 904,350
Add 10% for contingencies	90,435
Add 6% for engineering	59,687
Total cost	$1,054,472

A-2—Pressure Filters

12,000,000 gallons per day capacity.

Estimated at $12,500 per million gallons	$ 150,000
Add 10% for contingencies	15,000
Add 6% for engineering	9,900
Total cost	$ 174,900

A-3—Tunnel to Richmond

15,500 lin. ft. at $16.50	$ 256,000
Add 10% for contingencies	25,600
Add 6% for engineering	16,900
Total cost	$ 298,500

A-4-W—Distribution System

Using wood stave pipe for large sizes.

Pipes, 2 to 30 in.	$1,345,831
Hydrants	66,800
	$1,412,631
Add 10% for contingencies	141,263
Add 6% for engineering	93,233
Total cost	$1,647,127

A-4-S—Distribution System

Using riveted steel pipe for large sizes.

Pipes, 2 to 30 in.	$1,297,939
Hydrants	66,800
	$1,464,739
Add 10% for contingencies	146,474
Add 6% for engineering	96,673
Total cost	$1,707,886

A-4-I—Distribution System

Using cast iron pipe for large sizes.

Pipes, 2 to 30 in.	$1,580,819
Hydrants	66,800
	$1,647,619
Add 10% for contingencies	164,762
Add 6% for engineering	108,743
Total cost	$1,921,124

A-5—West Side Balancing Reservoir

Excavation, lining, fittings, etc.	$ 13,500
Add 10% for contingencies	1,350
	$ 14,850
Add 6% for engineering	890
Total cost	$ 15,740

A-6—Potrero Heights High Pressure System

Pipes, 2 to 10 in.	$ 23,765
Hydrants	1,800
Reservoir and pumping plant	6,400
Add 10% for contingencies	3,195
	$ 35,160
Add 6% for engineering	2,110
Total cost	$ 37,270

Summary of Costs of San Pablo Source

Using wood stave pipe for large sizes.

A-1—Reservoir complete	$1,054,472
A-2—Filters	174,900
A-3—Tunnel to Richmond	298,500
A-4-W—Distribution system	1,647,127
A-5—West side balancing reservoir	15,740
A-6—Potrero high pressure system	37,270
Total cost (exclusive of rights of way and lands)	$3,228,009

Summary of Costs of San Pablo Source

Using riveted steel pipe for large sizes.

A-1—Reservoir complete	$1,054,472
A-2—Filters	174,900
A-3—Tunnel to Richmond	298,500
A-4-S—Distribution system	1,707,886
A-5—West side balancing reservoir	15,740
A-6—Potrero high pressure system	37,270
Total cost (exclusive of rights of way and lands)	$3,288,766

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Summary of Costs of San Pablo Source

Using cast iron pipe for large sizes.

A-1—Reservoir complete	$1,054,472
A-2—Filters	174,900
A-3—Tunnel to Richmond	298,500
A-4-I—Distribution system	1,921,124
A-5—West side balancing reservoir	15,740
A-6—Potrero high pressure system	37,270
Total cost (exclusive of rights of way and lands)	$3,502,006

Group B—To Develop a Supply of 12,000,000 Gallons from the Sacramento River.

B-1—Pumping Plant at Toland's Landing

Building, grading, foundation, etc.	$ 5,400
Pile and timber wharf and support	4,500
Pipes, fitting, lifting derricks, etc.	1,500
Gasoline engine in place	7,000
Two 14-in. 2-stage centrif. pumps; Two 10-in. 2-stage centrif. pumps } in place complete.	6,250
Motors, transformers, and electric equipment	10,000
	$ 34,650
Add 10% for contingencies	3,465
Add 6% for engineering	2,287
Total cost	$ 40,402

B-2—Conduit from Toland's Landing to Emergency Intake at Antioch

B-2-W—Using wood stave pipe.

25,900 ft. of 36-in. pipe (head 200-250 ft.), complete in place	$ 127,140
3,430 lin. ft. 36-in. submarine crossings	80,000
Total, 29,330 ft.	$ 207,140
Add 10% for contingencies	20,714
Add 6% for engineering	13,671
Total cost	$ 241,525

B-2-S—Using riveted steel pipe.

25,900 ft. of 36-in. pipe (head 200-250 ft.), complete in place	$ 168,800
3,430 lin. ft. 36-in. submarine crossings	80,000
Total, 29,330 ft.	$ 248,800
Add 10% for contingencies	24,880
Add 6% for engineering	16,421
Total cost	$ 290,101

B-2-I—Using cast iron pipe.

25,900 ft. of 36-in. pipe (head 200-250 ft.), complete in place	$ 286,920
3,430 lin. ft. 36-in. submarine crossings	80,000
Total, 29,330 ft.	$ 366,290
Add 10% for contingencies	36,692
Add 6% for engineering	24,217
Total cost	$ 427,829

B-3—Emergency Intake at Antioch

Building, foundations, etc.	$ 5,400
Pile and timber wharf and pipe support	4,500
Pipes, fittings, lifting derrick, etc.	1,500
	$ 11,400
Add 10% for contingencies	1,140
Add 6% for engineering	760
Total cost	$ 13,300

B-4—Conduit from Emergency Intake at Antioch to Filters at Martinez

B-4-W—Using wood stave pipe.

114,300 ft. 36-in. pipe (head 0-200 ft.) complete in place	$ 426,844
Add 10% for contingencies	42,684
Add 6% for engineering	28,172
Total cost	$ 479,700

B-4-S—Using riveted steel pipe.

114,300 ft. 36-in. pipe (head 0-250 ft.), complete in place	$ 578,020
Add 10% for contingencies	57,802
Add 6% for engineering	38,149
Total cost	$ 673,971

B-4-I—Using cast iron pipe.

114,300 ft. 36-in. pipe (head 0-300 ft.), complete in place	$1,100,850
Add 10% for contingencies	110,085
Add 6% for engineering	72,656
Total cost	$1,283,591

B-5—Filter Plant at Martinez (Capacity 12 Million Gal. per Day)

12,000,000 gal. capacity at $12,500 per million gallons.	$ 150,000
Add 10% for contingencies	15,000
Add 6% for engineering	9,900
Total cost	$ 174,900

B-6—Booster Pumping Plant at Martinez

Building, gradings, foundations, etc.	$ 5,400
Gasoline engine in place	7,000
Two 14-in. 2-stage centrifugal pumps; Two 10-in. 2-stage centrifugal pumps } in place	6,250
Pipes, fittings, derrick, etc.	1,350
Motors, transformers, and electric equipment	10,000
	$ 30,000
Add 10% for contingencies	3,000
Add 6% for engineering	1,980
Total cost	$ 34,980

B-7—Conduit from Booster Pumps at Martinez to Martinez Reservoir

If the shore route is followed beyond Martinez reservoir, the pressure on this section will be somewhat larger than if the inland route is followed, due to the smaller friction loss in the latter case. This estimate (B-7) applies only in case the inland route is followed. For B-7, used with the shore route, the estimate has been combined with that of B-9 and is given complete from Martinez booster pumps to Richmond.

Following Inland Route

B-7-W-I—Using wood stave pipe.

9520 ft. 36-in. pipe (head 100-300 ft.), complete in place	$ 45,370
Add 10% for contingencies	4,537
Add 6% for engineering	2,994
Total cost	$ 52,901

B-7-S-I—Using riveted steel pipe.

9520 ft. 36-in. pipe (head 100-300 ft.), complete in place	$ 58,946
Add 10% for contingencies	5,895
Add 6% for engineering	3,890
Total cost	$ 68,731

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B-7-I-I—Using cast iron pipe.

9520 ft. 36-in. pipe (head 100-300 ft.), complete in place	$ 102,656
Add 10% for contingencies	10,266
Add 6% for engineering	6,775
Total cost	$ 119,697

B-8 Martinez Reservoir

Embankment and excavation for dam and spillway	$ 104,640
Concrete facing on water side of dam	10,000
Reinforced concrete spillway culverts, etc	5,760
Reinforced concrete intake tower, complete with valves and bridge	4,700
Clearing reservoir site	525
	$ 125,625
Add 10% for contingencies	12,563
Add 6% for engineering	8,291
Total cost	$ 146,479

Unit Prices Used in Making Above Estimate B-8

Excavation.

In earth, per cubic yard	$ .30
In rock, per cubic yard	1.00
Embankment in dam, per cubic yard	.50

Concrete.

Slope facing for dam, per square foot	$ .25
Reinforced spillway, culverts, etc., per cubic yard	12.00
Reinforced concrete intake tower, per cubic yard	20.00
Plain in tower base, per cubic yard	10.00
Clearing land, per acre	35.00

B-7 and B-9—Conduit from Booster Pumps to Richmond, Following Shore Route

B-7-W-S and B-9-W-S Shore Route Using Wood Stave Pipe

100,300 ft. 36-in. pipe (head 0-350 ft.), complete in place	$ 558,784
Add 10% for contingencies	55,878
Add 6% for engineering	36,880
Total cost	$ 651,542

B-7-S-S and B-9-S-S Shore Route Using Riveted Steel Pipe

100,300 ft. 36-in. pipe (head 0-400 ft.), complete in place	$ 698,888
Add 10% for contingencies	69,889
Add 6% for engineering	46,127
Total cost	$ 814,904

B-7-I-S and B-9-I-S Shore Route Using Cast Iron Pipe

100,300 ft. 36-in. pipe (head 0-400 ft.), complete in place	$1,193,302
Add 10% for contingencies	119,330
Add 6% for engineering	78,758
Total cost	$1,391,390

B-9—Inland Route, Including Tunnel

B-9-W-I Using Wood Stave Pipe

66,260 ft. 36-in. pipe (head 0-300 ft.), complete in place	$ 310,104
15,000 linear feet tunnel at $16.50 complete	247,500
	$ 557,604
Add 10% for contingencies	55,760
Add 6% for engineering	36,802
Total cost	$ 650,166

B-9-S-I Inland Route Using Riveted Steel Pipe from Martinez Reservoir to Richmond

66,260 ft. 36-in. pipe (head 0-300 ft.), complete in place	$ 378,864
15,000 linear feet tunnel at $16.50 complete	247,500
	$ 626,364
Add 10% for contingencies	62,636
Add 6% for engineering	41,340
Total cost	$ 730,340

B-9-I-I Inland Route Using Cast Iron Pipe from Martinez Reservoir to Richmond

66,260 ft. 36-in. pipe (head 0-300 ft.), complete in place	$ 712,170
15,000 linear feet tunnel at $16.50 complete	247,500
	$ 959,670
Add 10% for contingencies	95,967
Add 6% for engineering	63,338
Total cost	$1,118,975

For convenience in making comparison, the total costs of the conduit for the two alternate routes and for the three materials are herewith listed:

Conduit Using Shore Route and Wood Stave Pipe

	Feet.	
B-2-W	29,330	$ 241,525
B-4-W	114,300	497,700
B-7-W-S and B-9-W-S	100,300	651,542
	x243,930	*$1,390,767

xOr 46 miles.

*Or $5.71 per ft. average cost, or $30,200 per mile.

Conduit Using Shore Route and Riveted Steel Pipe

	Feet.	
B-2-S	29,330	$ 290,101
B-4-S	114,300	673,971
B-7-S-S and B-9-S-S	100,300	814,904
	x243,930	*$1,778,976

xOr 46 miles.

*Or $7.30 per ft., or $38,700 per mile.

Conduit Using Shore Route and Cast Iron Pipe

	Feet.	
B-2-I	29,330	$ 427,829
B-4-I	114,300	1,283,591
B-7-I-S and B-9-I-S	100,300	1,391,390
	x243,930	*$3,102,810

xOr 46 miles.

*Or $12.70 per ft., or $67,500 per mile.

Conduit Using Inland Route and Wood Stave Pipe

	Feet.	
B-2-W	29,330	$ 241,525
B-4-W	114,300	497,700
B-7-W-I	9,520	52,901
B-9-W-I	81,260	650,166
	x234,410	*$1,442,292

xOr 44.3 miles.

*Or $6.15 per ft., or $32,500 per mile.

Conduit Using Inland Route and Riveted Steel Pipe Including Tunnel

	Feet.	
B-2-S	29,330	$ 290,101
B-4-S	114,300	673,971

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	Feet.	
B-7-S-I	9,520	$ 68,731
B-9-S-I	81,260	730,340
	x234,410	*$1,763,143

xOr 44.3 miles.

*Or $7.53 per ft., or $39,800 per mile.

Conduit Using Inland Route and Cast Iron Pipe Including Tunnel

	Feet.	
B-2-I	29,330	$ 427,829
B-4-I	114,300	1,283,591
B-7-I-I	9,520	119,697
B-9-I-I	81,260	1,118,975
xOr 44.3 miles.	x234,410	*$2,950,092

*Or $12.58 per ft., or $66,500 per mile.

B-10 Main Distributing Reservoir at Richmond Junction Heights—Ultimate Capacity, 90 Million Gallons

Earthwork—excavation and embankment	$ 203,250
Concrete lining	71,920
Gate tower, culverts, spillways, etc.	15,320
	$ 290,490
Add 10% for contingencies	29,049
Add 6% for engineering	19,172
	$ 338,711

B-11 West Side Balancing Reservoir

Excavation and Embankment	$ 9,900
Concrete lining	3,600
	$ 13,500
Add 10% for contingencies	1,350
Add 6% for engineering	890
	$ 15,740

B-12 Summary of Pipes in Ultimate Distribution System

		B-12-W Large mains w.s.		B-12-S Large mains r.s.		B-12-I Large mains c.i.	
Size, feet.	Length, feet.	Unit cost.	Total cost.	Unit cost.	Total cost.	Unit cost.	Total cost.
2	473,690	$0.34	$161,050				
3	8,770	0.53	4,650				
4	236,950	0.77	182,450				
6	282,800	1.08	305,420				
8	149,020	1.50	223,530	Small sizes same for all systems			
10	34,640	2.15	74,480				
12	36,110	2.63	94,970				
14	8,160	3.24	26,440				
16	15,100	3.90ci	58,890				
18	5,100	2.00ws	10,200	2.70rs	13,770	4.59ci	23,410
20	24,170	2.25	54,380	2.95	71,300	5.61	135,590
24	21,650	2.70	58,460	3.50	75,780	7.03	152,200
30	11,740	3.25	38,160	4.38	51,420	9.99	117,283
1250 hydrants at $50.		62,500			62,500		62,500
	1,307,900		$1,355,580		$1,406,650		$1,622,863
Add 6% for engineering		81,350			84,400		97,372
Total cost		$1,436,930			$1,491,050		$1,720,235
Area served							6250 acres
Cost per acre		$230.00			$239.00		$275.00
Average cost per lin. ft.		1.00			1.14		1.31½

NOTE.—The unit prices used herein are large enough to cover the 10% allowed for contingencies in other portions of this report.

B-13—Potrero High Pressure Fire Protection System —Ultimate System

Summary of Pipes and Hydrants

Size, in.	Length, ft.	Unit cost, p.l.f.	Total cost.	
2	5400	$0.34	1,835	
6	6500	1.08	7,020	
8	1900	1.50	2,850	
10	5600	2.15	12,040	
36 hydrants at $50			1,800	
				$25,545
Reservoir:				
Excavation			$4,510	
Lining, valves, etc.			1,316	
				5,826
Pumping plant and machinery				1,212
				$32,583
Add 6% for engineering				1,957
Total cost				$34,540

NOTE.—The unit prices used herein are large enough to cover the 10% allowed for contingencies in other parts of this report.

Summary of Cost Estimates for Ultimate System—Shore Route—Using Wood Stave Pipe

Item.	Construction costs.	Land and right-of-way.	Total cost.
B-1 Intake pumps	$ 40,402	$ 600	$ 41,002
B-2-W Conduit	241,525	7,200	248,725
B-3 Emergency intake.	13,300	600	13,900
B-4-W Conduit	497,700	13,200	510,900
B-5 Filters	174,900	7,200	217,080
B-6 Booster pumps	34,980		
B-7-W-S and B-9-W-S Conduit	651,542	36,120	687,662
B-8 Martinez reservoir	146,479	7,200	153,679
B-10 Dist. reservoir...	338,711	90,000	428,711
B-11 Bal. reservoir....	15,740	12,000	27,740
B-12-W Dist. system..	1,436,930	.....	1,436,930
B-13 High pres. system	34,540	3,000	37,540
Total	$3,626,742	$177,120	$3,803,862
If Inland Route Is Used	+51,525	—35,220	+16,305
Total	$3,678,267	$141,900	$3,820,167

Summary of Cost Estimates for Ultimate System—Shore Route—Using Riveted Steel Pipe

Item.	Construction costs.	Land and right-of-way.	Total cost.
B-I Intake pumps	$ 40,402	$ 600	$ 41,002
B-2-S Conduit	290,101	7,200	297,301
B-3 Emergency intake	13,300	600	13,900
B-4-S Conduit	673,971	13,200	687,171
B-5 Filters	174,900	7,200	217,080
B-6 Booster pumps	34,980		
B-7-S-S and B-9-S-S Conduit	814,904	36,120	851,024
B-8 Martinez reservoir	146,479	7,200	153,679
B-10 Dist. reservoir...	338,711	90,000	428,711
B-11 Bal. reservoir....	15,740	12,000	27,740
B-12 Dist. system.....	1,491,050	.....	1,491,050
B-13 High pres. system	34,540	3,000	37,540
Total cost	$4,069,078	$177,120	$4,246,198

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If Inland Route Is Used

	—15,833	—35,220	—51,053
Total cost	$4,053,245	$141,900	$4,195,145

Summary of Cost Estimates for Ultimate System—Shore Route—Using Cast Iron Pipe

Item.	Construction costs.	Land and right-of-way.	Total cost.
B-1 Intake pumps	$ 40,402	$ 600	$ 41,002
B-2-I Conduit	27,829	7,200	435,029
B-3 Emergency intake	13,300	600	13,900
B-4-I Conduit	1,283,591	13,200	1,296,791
B-5 Filters	174,900	7,200	217,080
B-6 Booster pumps	34,980		
B-7-I-S and B-9-I-S Conduit	1,391,390	36,120	1,427,510
B-8 Martinez reservoir	146,479	7,200	153,679
B-10 District reservoir	338,711	90,000	428,711
B-11 Bal. reservoir	15,740	12,000	27,740
B-12-I Dist. system	1,720,235	.....	1,720,235
B-13 High pres. system	34,540	3,000	37,540
Total cost	$5,622,097	$177,120	$5,799,217

If Inland Route Is Used

	—152,718	—35,220	—187,938
Total cost	$5,469,379	$141,900	$5,611,279

Group C—Immediate—To Develop a Supply of Six Million Gallons per Day from the Sacramento River

In this segregation only those items to be a part of the present project will be enumerated, and they will be given numbers corresponding to the notation in the preceding discussion of the ultimate scheme.

C-1—Intake and Pumping Plant at Toland's Landing

Building, grading, foundations, etc	$ 5,400
Pile and timber wharf and supports	4,500
Pipes, fittings, lifting derrick, etc	1,500
Gasoline engine in place	7,000
1 14-in. 2-stage centrifugal pump 2 10-in. 2-stage centrifugal pump	4,200
Motors, transformers, electrical equipment	7,500
	$30,100
Add 10% for contingencies	3,010
	$33,110
Add 6% for engineering	2,000
Total cost	$35,110

C-2, C-3, and C-4 are the same as B-2, B-3, and B-4, discussed on previous pages, and estimated to cost as follows:

C-2 Conduit from Intake to Emergency Intake

C-2-W using wood stave pipe	$ 241,525
C-2-S using riveted steel pipe	290,101
C-2-I using cast iron pipe	427,829

C-3 Emergency Intake at Antioch

Same as B-3	$ 13,300

C-4 Conduit from Emergency Intake to Booster Pumps at Martinez

C-4-W using wood stave pipe	$ 497,700
C-4-S using riveted steel pipe	673,971
C-4-I using cast iron pipe	1,283,591

C-5 Filter Plant at Martinez. Capacity 6 Million Gallons.

Complete with building, settling basin, and appurtenances	$ 100,000
Add 10% for contingencies	10,000
	$110,000
Add 6% for engineering	6,600
Total cost	$ 116,600

C-6 Booster Pumps at Martinez

Building, grading, foundations, etc	$ 5,400
Gasoline engine in place	7,000
One 14-in. 2-stage centrifugal pump; 2 10-in. 2-stage centrifugal pump	4,200
Motors, transformers, electrical equipment	7,500
Piping, fittings, lifting derrick, etc	1,350
	$ 25,450
Add 10% for contingencies	2,545
Add 6% for engineering	1,680
Total cost	$ 29,675

Pipe-line same as under Segregation B. C-7 and C-9 same as B-7 and B-9. Martinez reservoir not included.

C-10 Main Distribution Reservoir. Capacity 30 Million Gal.

Excavation and embankment	$ 72,750
Concrete lining	34,573
Gate tower, spillway, etc	8,875
	$ 116,198
Add 10% for contingencies	11,620
Add 6% for engineering	7,669
Total cost	$ 135,487

C-12—Summary of Pipes in Proposed Immediate Distributing System

Size, ft.	Total length.	C-12-W Large mains w.s. Unit cost.	C-12-W Large mains w.s. Total cost.	C-12-S Large mains r.s. Unit cost.	C-12-S Large mains r.s. Total cost.	C-12-I Large mains c.i. Unit cost.	C-12-I Large mains c.i. Total cost.
2	97,000	$0.34	$32,980				
3	2,040	0.53	1,080				
4	69,000	0.77	53,130	Small sizes same for all systems			
6	71,000	1.08	76,680				
8	61,400	1.50	92,100				
10	10,900	2.15	23,430				
12	7,550	2.63	19,860				
14	8,160	3.24	26,440				
16	6,560ci	3.90	25,590				
18	5,100ws	2.00	10,200	$2.70	$13,750	$4.59	$23,400
20	24,170	2.25	54,380	2.95	71,250	5.61	135,500
24	17,650	2.70	47,655	3.50	61,800	7.03	124,000
30	11,740	3.25	38,155	4.38	51,500	8.12	95,300
238 hydrants at $50.			11,900	...	11,900	...	11,900
Total, 392,270 feet				$513,580	$561,490		$741,390
Add 6% for engineering			30,815		33,690		44,480
Grand total				$544,395	$595,180		$785,870
Area served							2300 acres
Cost per acre				$237	$259		$341

NOTE.—The unit prices used herein are large enough to cover the 10% allowed for contingencies in other portions of this report.

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C-13—Potrero High Pressure Fire Protection System—Immediate Installation.

Immediate System

Size, in.	Length, ft.	Unit cost, p.l.f.	Total cost.	
6	4600	$1.08	$ 4,970	
8	1900	1.50	2,850	
10	5600	2.15	12,050	
33 hydrants at $50			1,650	
Reservoir:				$21,520
Excavation			$4,510	
Lining, valves, etc.			1,316	
				5,826
Pumping plant and machinery				1,212
				$28,558
Add 6% for engineering				1,712
Total cost				$30,270

NOTE.—The unit prices used herein are large enough to cover the 10% allowed for contingencies in other portions of this report.

Summary of Cost Estimates for Immediate System—Shore Route—Using Wood Stave Pipe

Item.	Construction costs.	Land and right-of-way.	Total cost.
C-1 Intake pumps	$ 35,110	$ 600	$ 35,710
C-2-W Conduit	241,525	7,200	248,725
C-3 Emergency intake.	13,300	600	13,900
C-4-W Conduit	497,700	13,200	510,900
C-5 Filter, C-6 Booster pumps	116,600 / 29,675	7,200	153,475
C-7-W-S and C-9-W-S Conduit	651,542	36,120	687,662
C-10 Dist. reservoir	135,487	90,000	225,487
C-12-W Dist. system	544,395	.....	544,395
C-13 High pres. system	30,270	3,000	33,270
Total cost	$2,295,604	$157,920	$2,453,525
If inland route is used.	+51,525	—35,220	+16,305
Total cost	$2,347,129	$122,700	$2,469,829

Summary of Cost Estimates for Immediate System—Shore Route—Using Riveted Steel Pipe

Item.	Construction costs.	Land and right-of-way.	Total cost.
C-1 Intake pumps	$ 35,110	$ 600	$ 35,710
C-2-S Conduit	290,101	7,200	297,301
C-3 Emergency intake.	13,300	600	13,900
C-4-S Conduit	673,971	13,200	687,171
C-5 Filter, C-6 Booster pumps	116,600 / 29,675	7,200	153,475
C-7-S-S- and C-9-S-S-Conduit	814,904	36,120	851,024
C-10 Dist. reservoir	135,487	90,000	225,487
C-12-W Dist. system	595,180	.....	595,180
C-13 High pres. system	30,270	3,000	33,270
Total cost	$2,734,598	$157,920	$2,892,518
If inland route is used	+15,833	—35,220	—51,053
Total cost	$2,718,765	$122,700	$2,841,465

Summary of Cost Estimates for Immediate System—Shore Route—Using Cast Iron Pipe

Item.	Construction costs.	Land and right-of-way.	Total cost.
C-I Intake pumps	$ 35,110	$ 600	$ 35,710
C-2-I Conduit	427,829	7,200	435,029
C-3 Emergency intake	13,300	600	13,900
C-4-I Conduit	1,283,591	13,200	1,296,791
C-5 Filter, C-6 Booster pumps	116,600 / 29,675	7,200	153,475
C-7-I-S and C-9-I-S Conduit	1,391,390	36,120	1,427,510
C-10 Dist. reservoir	135,487	90,000	225,487
C-12-I Dist. system	785,870	.....	785,870
C-13 High pres. system	30,270	3,000	33,270
Total cost	$4,249,122	$157,920	$4,407,042
If inland route is used	—152,718	—35,220	—187,938
Total cost	$4,096,404	$122,700	$4,219,104

Effect of the European War on American Industry*

"A direct benefit to the United States from the European war will be its effect in making the people of this country realize to a greater extent the value of its mineral resources," said Franklin K. Lane, Secretary of the Interior, in an interview today. "It is entirely possible so to utilize these resources and expand our industries that the label 'Made in America' will become familiar in our own foreign markets.

"Of an importance second only to that of the food supply," said Mr. Lane, "is the supply of mineral products necessary to meet the requirements of twentieth century civilization. One of the first effects of the war has been to make us realize the interdependence of nations in the matter of food supply. Most of the countries now at war are dependent upon importation of foodstuffs, and we have cause for self-congratulation in the United States that we are able to feed ourselves. What we possibly have not so fully realized is that we are nearly as independent in the possession of essential mineral resources, and that the interference with manufacturing caused by interruption of the flow of importations of many necessary raw materials may be overcome almost wholly by development of neglected resources in our own country."

"Do you mean," Mr. Lane was asked, "that the United States can make itself independent of the rest of the world in its manufactures?"

"Very largely," asserted the Secretary. "The main difficulties to be overcome are in the rearrangement of the distribution system necessary to establishing this independence. Business is established along certain well marked channels, and usually follows the line of least resistance. It has been easier, and perhaps cheaper, to import mineral products and materials from other countries than to go to the trouble and

*An interview with Franklin K. Lane, Secretary of Interior.

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expense of developing our own resources of the same nature. Forced to the latter course by suspension of commerce with other countries, I believe that American enterprise and energy will almost at once turn to the development of the native resources, rather than permit production to lag and supply to be diminished in any industry.

"For the maintenance of agriculture, for instance, we rely more and more largely upon mineral fertilizers. The three essential plant foods are potash, nitrogen, and phosphorus, the latter used generally in the form of phosphates. We have depended, with the rest of the world, very largely upon the mines of Germany for our supply of potash salts, and war has cut off this supply, but we have large deposits of potash in a California reserve which can be immediately opened and developed if a bill now before Congress to make these supplies available is enacted. Chile holds a practical world monopoly of the most readily available nitrogen in its great nitrate beds, and not only the manufacture of agricultural fertilizers, but also of many kinds of high explosives, have been made dependent upon the Chilean supply of nitrates. If this supply should be cut off, a new supply would have to be found, or manufactures and agriculture would suffer. Fortunately, this new supply is at hand. We can draw nitrogen from the air and fix it with lime by the use of large and cheap electrical development, as is done at Niagara Falls and in Norway, and all that is necessary to pave the way to this electrical development is the passage by Congress of the Ferris bill now pending, which will make possible the utilization of the great unused water powers of the Western States.

"The Southern States have for years largely supplied the world with phosphates, but because of the distribution system a large part of this supply has gone to Europe, and much of the phosphates used in the Western States have been imported across the Pacific. We have some 3,000,000 acres of phosphate lands in the West lying near the smelters from which is produced the sulphuric acid necessary to convert these phosphates into form available for plant food, and still there is no law by which these phosphate deposits can be made commercially available, although a bill which would allow of their immediate development has been favorably reported by the Public Lands Committee of the House of Representatives, and is awaiting the approval of the House and Senate."

"Will these resources be developed if these laws are passed?" the Secretary was asked.

"Of course they will," he replied. "You can depend upon American enterprise and ambition to make good when it is given an opportunity. At present these deposits and resources are locked up out of use. To open them to use when the supply from other countries is cut off means to make American industries using these materials independent of the rest of the world, and business men will not neglect the opportunity to make our industries safe from the interruptions of war we are now experiencing."

"What other industries are there now dependent upon the products of other countries, which can be made independent?" Mr. Lane was asked.

"The steel industry, for one," he replied. "Manganese is of large importance to this industry, and the largest supply of ore comes from Russia and other countries with which commerce is now paralyzed. There are large deposits in South America which have not been developed, but it is not necessary even to go so far away as that. We have great stores of manganese in this country which has been largely untouched because it is somewhat inferior in quality. To bring this home supply into use means merely adoption of methods for its purification which are known and can be successfully used, and then we can continue making manganese steel without regard to foreign wars or sources of material. There are other international contributions, though, in the steel industry. We have depended largely upon the island of Ceylon for the graphite used in the manufacture of the crucibles in which crucible steel for edge tools and small firearms is made. Or, to take another metal, European smelters, using in part Chinese and Mexican ores, have in late years furnished much of the world's supply of antimony, which is used in the manufacture of type metal, and also medicinally. War has paralyzed the production of antimony in England (at Newcastle), and prices have gone up. Antimony, however, is easily extracted from many low-grade ores which we have in great quantities in at least seven states, and there is no reason why we should not make this extraction and be independent of other countries, both as to supply and prices. Similar conditions hold in the case of arsenic.

"A large tonnage of ferromanganese alloys comes from Germany and England. It is only in the last ten years that we have freed ourselves from Sicily's monopolistic control of the sulphur supply. Flint pebbles are common and the supply large enough in the United States, but for such an apparently unimportant product as these, used in the fine grinding of cement and ores, we have been depending upon the chalk cliffs of England, Denmark, and France. Ores and mineral freight depend almost wholly upon the tramp steamer, a carrier of foreign parentage. Now the tramp steamer has taken to cover, and all kinds of ocean freight, especially low-grade freight, will be held up and its carriage almost entirely suspended during the war."

"Will this result in disaster to our industries?"

"Not disaster, but inevitable interruption to some extent," replied Mr. Lane. "It means that suddenly materials upon which great industries depend must be obtained from other sources. Importers, consumers, and manufacturers are making anxious inquiries as to where they may find in the United States supplies of crude materials to replace the foreign supplies now

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shut off. This is the opportunity of the United States to free itself from dependence of its industries upon other countries, and business men are awakening to this fact. They look to the Government for aid in finding new sources of material with which to keep the factories open and in operation. When they have found the domestic supply and begin its use, they will not return to dependence upon the foreign supply, and thereafter good or bad times in the United States, so far as the maintenance of industries is concerned, will be more independent of foreign complications."

"What is the Government doing to aid industry in these matters?"

"All it can do under present laws," replied the Secretary. "The nation's greatest natural resources are a part of the public domain, and under the charge of the Interior Department. The annual reports on the mineral resources of the United States published by the U. S. Geological Survey for the last thirty years, contain not only statistics of yearly production of all commercial minerals, but also useful facts regarding the occurrence, exploitation, and application in the arts and sciences of the mineral wealth of the country. The Geological Survey has been instructed to furnish upon request the addresses of producers from whom buyers can supply their wants if the mineral is produced at all in this country, or information regarding the localities where reported deposits are undeveloped. In some instances large deposits remain undeveloped simply because of the fact that distance from market has given to the foreign sources of raw material, with lower ocean freights, an advantage over domestic producers shipping by rail."

"What immediate effects upon mineral industries may be expected from the war?" Mr. Lane was asked.

"Already the copper industry has felt the injurious effect of war," he said, "and production has been curtailed. While considerable copper is consumed in the munitions of war, the constructive arts of peace furnish a far better world market for American copper than will the destructive art of war. In the case of zinc, however, the effect of the European war is the opposite. The smelting centres of the Continent are in the zone of fighting. In Belgium, for instance, practically all the zinc smelters lie along the line of attack chosen by the German armies, while in Rhenish Prussia, Austria-Hungary, and Russian Poland the smelters are likewise located where military operations promise to be most active. It is within the limits of probability to expect a loss of a half million tons in the foreign production of zinc, or nearly half the world's output, with beneficial effect upon the recent overproduction in the United States, especially as affording the opportunity to export zinc and galvanized iron products to South American countries, which market has hitherto been only in part utilized by our exporters.

"Fuel oil has a large use in naval warfare of today, yet the tying up of the big tank steamers on both the Atlantic and Pacific seaports is already embarrassing the oil producers of this country who depend so largely upon the export trade in all the forms of petroleum, crude and refined. On the other hand, Russia, our strongest rival in oil production, must suffer more complete and longer continued interruption of exports, which should tend to enlarge the market for our oil.

"The supply of cheap foreign barytes has prevented the development of many good deposits of that mineral, but with the consumers on the Atlantic seaboard already looking for domestic supplies, some of the Southern mines should be reopened to supplement the outputs of those already in operation.

"The closure of the European market leaves but one buyer for the radium ores of Colorado and Utah, which is decidedly to the disadvantage of the miner. Had the legislation introduced in Congress been promptly enacted, the United States Government would probably have been buying these ores at this time.

"While the United States leads in coal mines," continued the Secretary, "the six European nations now at war happen to be the six next largest coal mining countries, producing together over half the world's coal. Interference with both the mining and the commerce of these nations must necessarily increase the demand for our coal at least in the neutral countries of the world. And coal is our one resource about which there need be no present anxiety. The United States is now producing 40% of the world's supply of coal, and the reserves yet to be drawn upon exceed, so far as known, those of all the rest of the world combined. It is not generally known, however, to what an extent we have been depending upon Europe, principally Germany, for many of the chemical products derivable from coal, and which we have been permitting to go to waste in the most reckless manner. Coal tar obtained in the manufacture of coal gas and of coke (in retort ovens) is capable of producing hundreds of chemical products, but the chemical industries dependent upon coal tar as a raw material have had little development in the United States. Our imports of coal tar products in 1913 were valued at $11,000,000 at initiating points, and when they reached the ultimate consumer probably cost double that amount. If the present war continues any length of time, the American consumer will have to do without aniline colors and dyes, certain drugs, and numerous other coal tar products, or the American manufacturers will undertake to supply these essential commodities which have hitherto carried the label 'Made in Germany.'

"The Panama canal is opened in time to help us in many ways. Bolivia, for instance, is one of the greatest tin-producing countries in the world, but its heaviest exportations have been to Europe, and the United States has been getting its supply of materials for the manufacture of tin plate and tin alloys from London and Liverpool. With the suspension of European industry and the opening of the canal, there is no good reason why we should not step in, bring Bolivia's tin ore to this country and manufacture it."

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State Aid Highway Construction in Illinois

The state of Illinois, according to *Engineering and Contracting*, is about to begin construction work on the first highways to be improved under its new state aid law. Plans have been completed for a number of undertakings and bids have been asked on the first list of contracts. The following tabulation shows the roads for which plans have been completed:

County.		Route.	Section.	Length, miles.
Bond	Brick	7	A	0.30
Vermilion	Brick	2	A	3.05
Cook	Concrete	38	B	1.34
Cook	Concrete	32	A	0.50
Livingston	Concrete	11	A	2.36
Lake	Concrete	6	A	2.01
Iroquois	Concrete	7	A	2.46
Iroquois	Concrete	7	B	2.52
Champaign	Brick	5	B	1.17
Champaign	Brick	7	C	1.08
Champaign	Brick	3	A	1.25
Coles	Concrete	15 & 8	A	1.37
Sangamon	Concrete	3C	B	0.53
Sangamon	Concrete	9	E	0.51
Sangamon	Concrete	5	C	0.59
Sangamon	Concrete	6 & 7	D	0.49
Sangamon	Concrete	2	A	0.55
Peoria	Concrete	..	A	1.17
Edgar	Brick	6	B	0.85
Edgar	Brick	2	A	0.80
Schuyler	Concrete	5	A	1.02
Monroe	Concrete	1	A	0.36
Clark	Concrete	1	A	0.85
Franklin	Concrete	1A & 1	A	0.83
Crawford	Concrete	3	B	3.41
Ogle	Brick	3	A	1.61

The present policy of the State Highway Department is that nearly all of the state aid roads will be constructed of either brick or concrete, 10 or 18 ft. in width, and with or without macadam shoulders. The standard section for double track concrete roads calls for an 18 ft. width of concrete and two 6-ft. shoulders. The concrete will be 8 in. thick in the centre and 6 in. thick at the sides. Under each side of the paved surface there will be a longitudinal drain, with 6-in. blind lateral drains at intervals. Four sections of the double track concrete roads are provided. These sections differ principally in the arrangement of the shoulders and side ditches. The section to be used in a level country will have a side ditch 1½ ft. deep with a bottom width of 1 ft. and slopes of 2 to 1. Another section especially adapted for low lying level country provides for 18-ft. concrete roadway with broad side ditches available for traffic when width between fences permits. The total width of this roadway between the outer edges of the broad ditches is 40 ft. The shoulder proper is 5 ft. wide. For use on deep fills the total width of the roadway will be 25 ft., consisting of two 3½-ft. shoulders and the 18-ft. paved portion. The side slopes on the fill will be 2 to 1. One feature of this section is the provision for a small berm at the end of each shoulder to prevent the water running down the sides of the fill. In locations where there are deep cuts and on grades that require grouted gutters, the total width of the roadway will be 21 ft., the two shoulders 1½ ft. each, forming part of the gutter, which is carried up on the 1 to 1 slopes well above the crown to the pavement.

Five standard sections for single track concrete roads are provided. In general, this road will have a 10-ft. surface, the concrete being 7 in. thick at the centre and 5 in. thick at the sides. Longitudinal drains and side lateral drains will be employed as in the double-track roads. For single-track roads in deep cuts and on grades that require grouted gutters the standard section calls for a 15-ft. concrete roadway, 8 in. thick at the centre and 6 in. thick at the edges. All the other sections provide for a 10-ft. roadway with 4-ft. shoulders composed of 5 in. of macadam. In addition to the sections mentioned above, standards have been prepared for concrete roads on fills that require gutters. One of these provides for 14-ft. concrete surface with a 6-in. wide, 12-in. high concrete curb and 3½ ft. raised earth shoulders. Other types provide for a 15 or 18-ft. concrete surface with grouted curbs and gutters and raised earth shoulders.

The standard sections for double-track brick roads, in general, provide for an 18-ft. surface of 4-in. brick, on a 1-in. sand cushion and a concrete base. The curb will be 6 in. wide and monolithic with a base. The latter will be 5½ in. thick at the centre and 3½ in. thick at the sides. Longitudinal side drains and blind lateral drains will be placed under the concrete base at the sides. The sections to be employed in level country provide for 6-ft. shoulders and a side ditch 1½ ft. deep with a bottom width of 1 ft. Other sections provide for an 18-ft. brick roadway with concrete curb and raised earth shoulders and for a 15 or 18-ft. brick roadway with grouted curb and gutters and raised earth shoulders. These sections are to be used in cases where the location lies on fills that require gutters. Sections are also provided for brick roadway with broad side ditches, for roadway constructed on deep fills, and in deep cuts and on grades that require grouted gutters. The details of the shoulders, ditches, etc., are in general like those for the 18-ft. concrete roadway.

The standard macadam sections provide for a 12-ft. surface composed of two courses of 4 in. of broken stone.

It is impossible at this time to state the total mileage of the work that will be let this year. Plans for a great many miles of road work are now under way and it is expected that contracts will soon be let.

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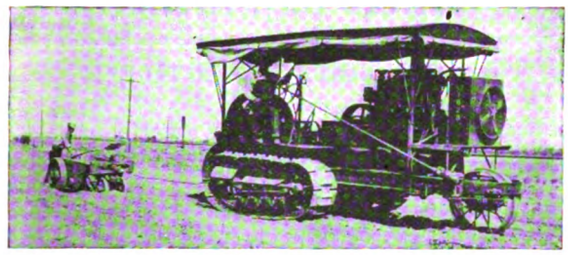
Industrial Progress

THE HOLT CATERPILLAR TRACTOR

Contractors are always on the lookout for methods by which they may reduce their general overhead expense. One of the commonest cost-cutting methods which large contractors have adopted during the past few years is shown by the accompanying illustrations. The horse is being replaced by motor power.

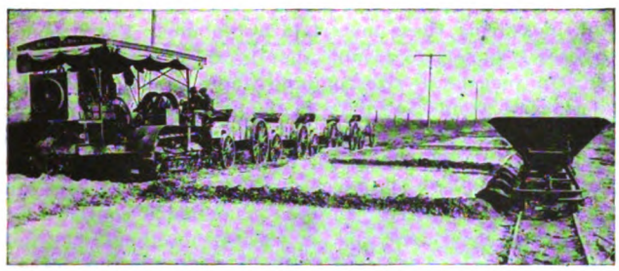
It seems to be a foregone conclusion that while the horse may never be entirely replaced, it is doomed to become a back number and the problem the contractor has to solve today is not whether he will use mechanical instead of horse power, but rather what type of motor power he will use.

In the early days of tractor manufacturing, the round-



HOLT CATERPILLAR TRACTOR PULLING SCARIFIER.

wheel type was universal, but in 1904 Ben C. Holt, president of the Holt Manufacturing Company at Stockton, California, conceived the idea of an endless track to supplant these large wheels. He was prompted to work out this idea because the round-wheels did not furnish enough traction, because they slipped and mired in wet weather and would not operate successfully in sandy soil. Mr. Holt knew the



HOLT CATERPILLAR TRACTOR DELIVERING CONCRETE AGGREGATE FOR ROAD WORK.

round-wheel type thoroughly because he had manufactured it for ten years, and the ten year's experience enabled him to work out this endless-track idea. The caterpillar tractor is the result, and the illustration shows plainly how it lays its own track, rolls over it and picks it up. It shows also the immense bearing surface as compared to the old round-wheel style. There is eight times as much bearing surface on this track as there is on the round wheel. As a consequence, more of the motor power is delivered at the drawbar because no power is lost through slippage. This additional surface enables the tractor to operate over roads of mud, sand, snow, ice or ruts without much difficulty. On a wet and muddy surface it supports the weight of the tractor just as a board placed over a mudhole supports the weight of a man.

A slight rain will sometimes tie up an entire road-building crew and their machinery until the road has dried enough to allow the round-wheel engine to proceed. These expensive delays work considerable injury to a contractor and every contractor knows just what this experience is. The caterpillar is working in swamps so soft that a pole may be shoved down by hand 10 or 15 ft. into the mud. Surely, then, no contractor need be idle through bad ground or weather if he operates this type of tractor.

Interest on the money you put into a tractor is figured by the calendar day. It goes on whether you work or not. The only way to beat the interest game is to get a profit by working more days every year. Every day's idle rusting means that part of the tractor's value is absolutely lost. Contractors take chances, therefore, when they use a tractor which will not work under all conditions, even though its first cost might be small.

Mr. M. G. Ashley, a logging contractor of Cle Elum, Washington, has this to say concerning his tractor, which is a caterpillar:

"I have horse teams hauling beside the engine to test out its superiority. I find that it would require nine teams of horses to haul the same number of feet that the engine hauls each day. The upkeep of these horses, here at the present going prices of feed would at the least calculation be $14 per day. I would have to hire a teamster for each of these nine teams, which would cost me at the rate of $3 per day or $27, making a total expense of $41 per day for teams.

On the other hand the cost of upkeep for the engine each day that it works is approximately $4 per day for all the oil and $9.50 for engineer and helper, making a total expense of $13.50.

This difference between hauling the same number of feet with horses and with the engine, which is $27.50, is a clear profit to me.

The above figures have been made on actual working days. The profits in favor of the caterpillar are greater to me in the long run, because when the roads are unfavorable for hauling, the engine costs me absolutely nothing, while the teams are eating the same amount of feed or more."

Mr. F. G. Valentine, of Lewiston, Montana, has written some interesting facts concerning his machine:

"As I am operating a caterpillar, pulling a Western elevator grader for Mr. D. J. Burke in railroad construction and working in 'gumbo' and hard shale that is considered by all contractors to be difficult material to handle, my fuel consumption and oils are so low that I thought perhaps you would like to know about it.

I work ten hours every day strong, and burn about 25 to 30 gallons of gasoline and about ½ gallon of lubricating oil.

The oil system and cooling device are perfection.

I filled my water tank five weeks ago today and have used four pails of that in blasting rock, where it was very hot and the engine never showed heating. The engine is perfection in every way."

The figures given below were compiled recently by a prospective purchaser. For twenty-one consecutive days he kept an accurate record of the work done by the caterpillar in hauling logs:

Labor	$312.80
Fuel	129.50
Oil	59.50
Maintenance	108.00
Total	$609.80
Average number of trips per day	2.2
Average truck load	2,000 ft.
Average hauled each day	18,300 ft.
Grades of road	5 to 20%
Length of haul	3½ to 4 miles
Total logs hauled	384,420 ft. B. M.
Average cost per M	$1.58

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These tractors are no longer an experiment. The figures above speak for themselves and contractors who now operate tractors would not think of returning to the old system of maintaining a big camp of horses.

ELECTRICAL STEEL FURNACE IN OPERATION AT WASHINGTON IRON WORKS, SEATTLE

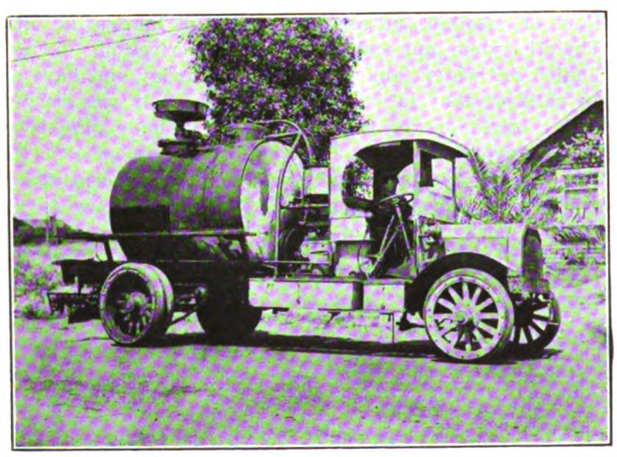
The Washington Iron Works, Seattle, has recently installed an electrical steel casting furnace to care for the increasing demand for high grade steel castings, in the manufacture of their logging and hoisting equipment.

ELECTRIC FURNACE AT WASHINGTON IRON WORKS.

This furnace is now in successful operation and is the only one in the United States making steel castings from cold charges direct from furnace to molds. It is claimed that the very highest grade of steel can be made by the electric process, its superior points over fuel melted steels being greater density, and tensile strength, uniformity and freedom from blow-holes.

PEERLESS IN ROAD OILING WORK

The problem of applying oil to the road surface at a distance of 20 miles or more from the starting point and to spread the material at a heat of 200° or over, is one which has been



PEERLESS 5-TON MOTOR TRUCK, ADAPTED FOR ROAD OILING.

solved effectually by the road commissioners of Los Angeles county, California, by the use of a Peerless five-ton truck. As will be noted by the accompanying illustration the body has been especially designed for the purpose.

The chassis is fitted with a 1000-gallon oil tank, and the latter is covered with a coating of asbestos 2 in. thick. Oil is run into the tank at a temperature of 350°F., and thanks to the heat retaining quality of the asbestos protection and the speed at which the truck may be driven, it is possible to cover as many as 35 to 40 miles before the oil is too cold for use.

Air pressure of 60 lb. to the sq. in. is maintained inside the tank by an air compressor operated by the same mechanism as that used to actuate the dumping body for sand and gravel utilized with the trucks. Heat from the motor exhaust is utilized to keep the oil spreader warm so that the material will not thicken and clog up at that point.

This machine covers an average of 50 miles a day, and the driver states that in 2000 miles of service only two involuntary stops were necessary on the road, both of these being caused by dirty gasoline stopping up the fuel line.

Hints on Practice

CONCRETE DRAIN TILE*

Ordinary clay drain tile has, in a majority of cases, to be shipped from some distant point, with consequent loss due to transportation charges and breakage. To overcome this difficulty cement-concrete tile are now being made where used. The owner of the property is often fortunate enough to have an ample supply of sand and gravel, either on his own land or nearby. These two comprise the bulk of the materials used in the manufacture of concrete tile. For the smaller sizes it is not necessary to have gravel, as only portland cement and sand are used.

A portland cement of any standard brand will be suitable. The sand should be clean and coarse, with the particles well graded from fine up to ¼ in. in size. If gravel is used for very large pipes, it should be clean and also well graded in size, the pebbles running from ¼ to ¾ in. diameter. When only cement and sand are used the concrete should be mixed in the proportion of 1 part portland cement to 2½ or 3 parts sand, measuring these materials by volume. For measuring purposes it is safe to assume that 1 bag of cement is 1 cubic foot. In very large sizes of pipe where gravel can be used, the concrete should be mixed in the proportion of 1 part portland cement to 2 parts sand to 4 parts gravel. For most people a simple hand-mold for making pipe will be sufficient. These hand-molds are inexpensive and turn out pipe quite rapidly when properly operated. The molds consist of two cylinders of sheet iron, one set within the other. The inside cylinder is collapsible and the outside cylinder can be removed in sections. When hand-molds are used it is good practice to make up the tile during the winter, doing the mixing and placing of the concrete indoors, where there will be no danger of freezing. After the tile have become well hardened, say in about two weeks or one month, they can be placed outdoors until used.

MIXING THE CONCRETE.—The first requisite for the proper mixing of concrete is a well-made mixing board or platform. This platform should be made of boards carefully matched, in order that good tight joints will result. This will prevent any waste of cement and water from leaking through. A mixing platform 10 ft. square will be large enough for all ordinary purposes. It is well to nail around the outside of the board a strip 1 in. in height, which will prevent the concrete from working over the edges. The tools necessary for mixing are generally at hand. They consist of shovels, rakes, and hoes, and one or two water buckets. It is convenient to construct a bottomless measuring box for measuring the sand

*From data furnished by Standard Portland Cement Co., San Francisco.

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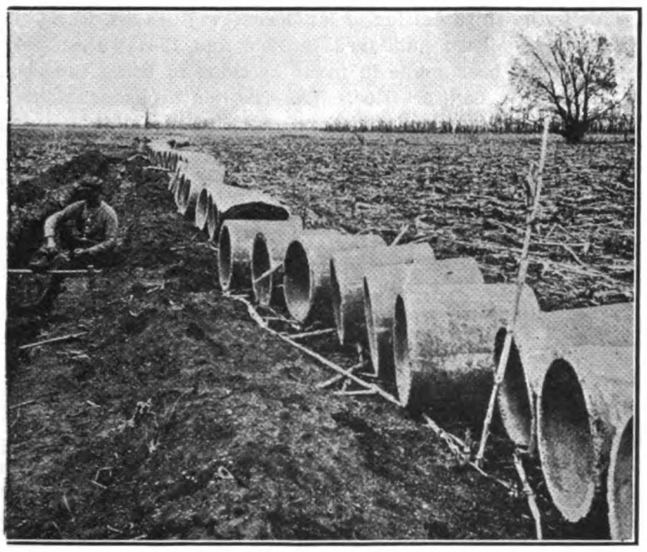
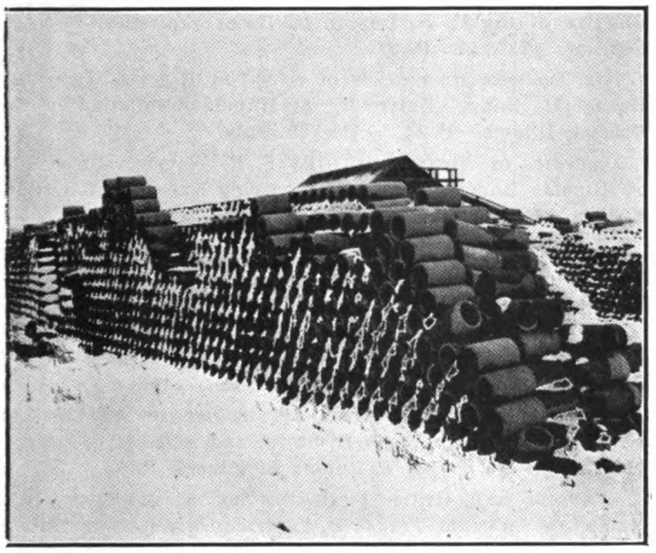
and gravel. The size of this box is determined by the proportions to be used. For a mixture of 1 part cement to 3 parts sand, the measuring box should contain 3 cu. ft. The sand and cement should be thoroughly mixed in the dry state, so that no streakiness or unevenness of color can be seen. When this is accomplished the water should be added, taking care that too much is not applied at first. The mixture should then be turned and mixed until a paste of even consistency results. For use in tile work the concrete should not be too



CEMENT TILE READY FOR LAYING.

wet. It should be what is called a dry mix. This dry mix is used so that the fresh concrete will hold its shape when the molds are removed.

MAKING THE PIPE.—Before starting to mix the concrete the molds should be set in place on a level and solidly supported board platform. In setting up the molds the directions con-



CEMENT TILE STORED IN THE OPEN, UNAFFECTED BY FREEZING.

tained in the printed matter accompanying them should be followed. The surfaces of the molds which come in contact with the concrete should be well oiled with a heavy lubricating oil, which will prevent the fresh concrete from adhering to the iron. Deposit 2 or 3 in. of concrete in the molds and then commence the tamping. This tamping is accomplished by a long-handled tamper furnished with the molds, and so designed as to pass easily between the inner and outer mold. Continue depositing and tamping the concrete until the mold is full. Be careful to fill the mold gradually. If half filled with concrete at the start and then tamped this will not result in a strong and uniform pipe. The tamping should be done continuously from the time the first concrete is deposited until the mold is full. When the concrete reaches the top it should be struck off to a smooth even surface with a trowel or float. As soon as it is deposited and tamping is completed the molds can be removed. In doing this care should be taken to avoid jarring the fresh concrete, as this might result in the collapse of the pipe.

CURING THE PIPES.—After the molds are removed the pipes should be allowed to rest undisturbed for 24 hours. They should then be kept wet by means of sprinkling or covering with burlap or rough cloth. Keep the covering moist. The pipe should not be allowed to dry out for at least one week. It will be found that this curing will add greatly to the strength and durability of the pipe. After thorough curing, the pipe can be removed to the storage place. It should not be roughly handled, however, until one or two months of age. During the winter time it is best to protect the tile from freezing temperature until one month after making. Hand-molds may be obtained for making either plain straight pipe or pipe with bell and spigot ends. Bell end pipe is somewhat more difficult to make. There are several machines on the market which run by power and which turn out tile in much larger quantities than can be done with the small hand-molds. These machines are costly and would be necessary only where the quantity of pipe would be sufficiently large to warrant the extra expenditure.

In conclusion, success in this undertaking, as in every other form of concrete construction, depends upon the selection of proper materials and careful and thorough workmanship.

Book Reviews

INFLUENCE DIAGRAMS FOR THE DETERMINATION OF MAXIMUM MOVEMENTS IN TRUSSES AND BEAMS. By Malverd A. Howe. John Wiley & Sons, New York. P. 65. Index. For sale by *Mining and Scientific Press*, San Francisco. Price $1.25.

While the use of influence lines for the determination of maximum moments and criterions for wheel loads is not by any means new, the author has directed attention to the fact that for loads on all ordinary trusses the influence diagrams for bending moments may be drawn by following a simple rule, and that no computations are required for the direct application of such diagrams when so constructed. It is also brought out that these diagrams may as easily be drawn for stresses or even areas of truss members as for bending moments. Short cuts and improved methods of making calculations are always welcome, and engineers will appreciate the value of Mr. Howe's work for this reason.

ENGINEERS' HAND-BOOK OF FAN ENGINEERING. Edited by Willis H. Carrier. The Buffalo Forge Co., Buffalo, New York. P. 567. Index. For sale by *Mining and Scientific Press*, San Francisco. Price $3.

When a manufacturer of apparatus gives to those whose experience has been comparatively limited the knowledge gained at the cost of much time and money, it is indicative of an exceptionally broad viewpoint, with respect to the commercial as well as the professional phases of his trade. A chief engineer in an establishment such as the Buffalo Forge Company has countless problems to pass upon daily where the consulting engineer of average practice may only encounter a few in a year. That this is an age of specialization has been iterated and reiterated so many times that most

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of us know it by now, nevertheless a keen appreciation of the value of this publication as the matured judgment of an organization of specialists is at once manifest by even a casual inspection of the text.

Air is one of the elements without which we cannot live, and as it falls to the lot of the engineer and architect, and then the contractor to see that no structure is erected in which adequate provision for a constant and pure supply is not available, an understanding of the functions of the fan is the keystone in the arch. The fan and its connections, and the matter handled thereby, make up the whole of the subject matter, and are treated in every possible phase and detail. The greater part of the data presented are not to be found in any text book, but are the result of experience and tests obtained from many years practice. An outline of the contents includes: Properties of Air; Applications; Air Ducts; Apparatus; and an Appendix.

Foundations of Bridges and Buildings. By Henry S. Jacoby and Roland P. Davis. McGraw Hill Book Co., New York. P. 597. Index. For sale by *Mining and Scientific Press*, San Francisco. Price $5.

Here is a work that is devoted to American engineering practice exclusively, and in which practically no reference is made to methods in vogue abroad. Appreciating the prevalence of piling for foundation work in the United States, the authors have alloted a generous amount of space to this branch of the subject, giving many examples of practical experience to exemplify the fundamental data. The data presented on concrete as a material for the manufacture of piles is of exceptional value.

The pneumatic process for the handling and placing of concrete is another of the more recent methods that is discussed and also supplemented by a chapter on pneumatic caisson practice by T. Kennard Thompson, whose experience in foundation work has been extensive. Piers and abutments are alloted three chapters in which are discussed the newer types, such as those having hollow or arched forms, as well as the older designs. The following summary of the subdivisions under which the general subject has been treated will give a good idea of the scope of the book: Timber Piles and Drivers; Driving Timber Piles; Bearing Power of Piles; Concrete Piles; Metal and Sheet Piles; Cofferdams; Box and Open Caissons; Pneumatic Caissons for Bridges; Pneumatic Caissons for Buildings; Pier Foundations in Open Wells; Ordinary Bridge Piers; Cylinder and Pivot Piers; Bridge Abutments; Spread Foundations; Underpinning Buildings; Explorations and Unit Loads; Pneumatic Caisson Practice and References to Engineering Literature.

Symmetrical Masonry Arches. Second Edition. By Malverd A. Howe. John Wiley & Sons, New York. P. 241. Index. For sale by *Mining and Scientific Press*, San Francisco. Price $2.50.

The author has taken up the design of masonry arches according to the elastic theory, and in order to facilitate the ready solution of the ordinary problems such as are encountered by the engineer during his regular practice, a greater part of the book is taken up in the solution of examples. Each step is given in detail so as to be readily followed by the student and engineer who has not specialized particularly along this line.

Much care has been taken to simplify the ordinary problems encountered, with the idea in view of affording short and simple solutions of such problems as do not require minute analyses. Both numerical and graphical tables are given, compiled from arch bridges already in existence and form a valuable aid in checking calculations. What the author terms as the simplest solution of the formulas for the horizontal thrusts and bending moments at the supports are given for the first time. The general subject is treated under the subdivisions of Fundamental Formulas; Symmetrical Arches Fixed at the Ends; Examples Showing the Application of the Formulas; Typical Arches; and an extensive appendix containing tables and miscellaneous data applicable to the subject.

Power and Power Transmission. By E. W. Kerr. John Wiley & Sons, New York. P. 373. Index. For sale by *Mining and Scientific Press*, San Francisco. Price $2.

This is the third edition of Mr. Kerr's well known work, the others having been published in 1902 and 1908 respectively. Revision has been made in many sections to bring the book up to present day practice. The chapter on internal combustion engines in particular has been entirely rewritten and enlarged.

Recent Publications

The Rollins Magazine, July, 1914. E. H. Rollins & Son, San Francisco.

N. L. S. E. Co. News, May 1914. The Heavy Oil Engine, Groton, Connecticut.

Colorado School of Mines Magazine, Alumni Register, July, 1914. Golden, Colorado.

The Production of Abrasive Materials in 1913. By Frank J. Katz. U. S. Geological Survey.

Flumes and Fluming. By Eugene S. Bruce. U. S. Department of Agriculture, Bulletin No. 87. P. 32.

Powers of Cities. Commonwealth Club, San Francisco, California. *Transactions*, Vol. 9, No. 6. P. 351-416.

Five Lectures Concerning Transportation. By Logan G. McPherson. Johns Hopkins University. Baltimore, Maryland. P. 110.

Brass Furnace Practice in the United States. Bulletin 73, Mineral Technology 14. By H. W. Gillett. U. S. Bureau of Mines. P. 289, index.

Lead Poisoning in the Smelting and Refining of Lead. Bulletin of the U. S. Bureau of Labor Statistics, No. 141. February 17, 1914. P. 97.

The Tractive Resistance of a 28-Ton Electric Car. By Harold H. Dunn. University of Illinois. Bulletin No. 74. Urbana, Illinois. P. 63. Price 25 cents.

Acoustics of Auditoriums. By F. R. Watson. University of Illinois. Bulletin No. 73, Engineering Experiment Station. Urbana, Illinois. P. 32. Price 25 cents.

Minerals of California. Bulletin No. 67. California State Mining Bureau. F. McN. Hamilton, state mineralogist. Ferry building, San Francisco, Cal. P. 219, index.

Methods of Oil Recovery in California. Technical Paper No. 70, Petroleum Technology No. 16, U. S. Bureau of Mines. By Ralph Arnold and V. R. Garfias. P. 57, index.

Specific Gravity Separation Applied to the Analysis of Mining Explosives. By C. G. Storm and A. L. Hyde. Technical Paper No. 78, U. S. Bureau of Mines. P. 13.

Magnetic and Other Properties of Electrolytic Iron Melted in Vacuo, by Trygve D. Yensen. University of Illinois Bulletin No. 72. Urbana, Illinois. P. 71. Price 40 cents.

The Electric Power Club. Executive staff, member companies, committees, constitution and by-laws, nomenclature and index. F. B. Crocker, president, Ampere, New Jersey.

Reports of the Investigations on Drain Tile of Committee C-6 on standard tests and specifications for drain tile, American Society for Testing Materials. Bulletin 36, Engineering Experiment Station, Iowa State College of Agriculture and Mechanic Arts. Ames, Iowa.

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Engineers' Note Book

TROUBLES IN PUMPING WELLS, CAUSES, AND REMEDIES

By DORSEY HAGER

Location.	Trouble.	Cause.	Indices.	Remedy
RODS	Parted.	Sudden strain on weak rods due to starting engine too suddenly. Pump plunger sanded and sticks tight and rods break.	Engine runs away. Walking beam moves freely without strain or lift when unhitched from wrist pin; is not pulled down by rods. Rods pull easily from tubing.	Screw rods together in hole and snap if possible. If rods will not screw up, pull rods and replace broken parts. If sanded up, pull tubing.
	Unscrewed.	Plunger 'sanded up.' Spring or twist in rods unscrews them from one another. Loose boxes or pins unscrew.	Rods pull very easily from tubing.	
PUMP	Cage unscrewed.	'Sanded up.'	Rods pull out easily, as if they have parted.	Screw on in hole if possible; if not, pull rods and tubing.
	Plunger leathers worn out. Valve seats worn out. Valve balls worn. Plunger worn. Working barrel worn. Valve leathers worn.	Wear and tear of sand on pumping parts.	Back suction due to slippage of fluid past pump.	Pull plunger and replace worn parts. Pull working barrel if necessary.
	Clogged pump.	Sudden inrush of sand, or settling of sand around plunger when well is stopped causes sanded conditions.	Plunger sticks in barrel. Rods stick up when beam moves downward.	Pull rods and tubing. Clean well by bailing or swabbing. Replace pump.
TUBING	Holes in tubing.	Wear and tear of rods on tubing.	Fluid will not stand in tubing. Water introduced in tubing sinks rapidly. Back suction noted.	Pull tubing and replace defective joints.
	Too high above fluid level.	Fluid level lowers by continuous pumping or by clogging of casing.	Plunger lifts, but no fluid results, though fluid level in tubing does not reduce.	Lower tubing below fluid level.
	Parted tubing.	Pump sands up. Rods striking down react on tubing.	Same as with parted rods. Seldom occurs.	Pull rods and tubing. Fish out dropped tubing.
CASING	Collapsed casing. Broken off casing.	Rock, water, or excessive gas pressure.	Tubing is held tight when attempt to pull it is made. Bailer will not enter casing, fishing tools will not enter casing. Impression block shows marks of casing.	Re-drill well and put in new casing.
	Holes in casing.	Cut by bailer, eaten by water.	Water in hole.	
	Defective cementing.	Failure of circulation. Insufficient cement; does not set.	Water in well.	Re-drilling and re-cementing.

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Company Reports

Sutter Butte Canal Co., of Gridley, reports for 1913 as follows:

ASSETS

Fixed capital	$1,105,699.95
Cash	1,851.42
Accounts receivable	37,608.80
Investments	377,008.55
Other assets	24,098.75
Deficit	676,910.57
Total	$2,223,178.04

LIABILITIES

Assessments	$ 247,700.00
Capital stock	1,250,000.00
Funded debt	618,784.65
Accounts payable	65,000.00
Other liabilities	41,693.39
Total	$2,223,178.04

PROFIT AND LOSS

Operating revenue	$ 50,617.20
Operating expenses	25,943.49
Net operating revenue	$ 24,673.71
Non-operating revenue and expenses, etc	8,229.95
	$ 32,903.66
Less taxes, interest, etc	70,783.41
Deficit	$ 37,879.75
Balance December 31, 1912 (deficit)	33,939.63
Deficit	$ 71,819.38
Additions	69.41
Deficit	$ 71,749.97
Other deductions	605,160.60
Balance (deficit)	$ 676,910.57

San Pedro, Los Angeles & Salt Lake Railroad has been granted authority by the California Railroad Commission to issue $861,000 first mortgage bonds. The proceeds from these bonds are to be used for the purpose of discharging and refunding obligations incurred for capital expenditures made subsequent to the expenditures involved in the Commission's decision of June 21, 1913, authorizing the railroad company to issue bonds of the face value of $1,119,000. It was made a condition of the order that these bonds shall be issued so as to net the railroad company not less than 90% of their face value in cash plus accrued interest. The Company proposes to issue these bonds to the Oregon Short Line Railroad Company and W. A. Clark, who are the owners of its capital stock. The bonds will bear interest at the rate of 4% per annum.

Pacific Gas and Electric Co. has filed an application with the California Railroad Commission for authority to issue $12,500,000 of first preferred stock and $5,000,000 of its general and refunding bonds. The Company proposes to sell the stock at $82.50 per share, and asks for authority to sell the bonds at a future date at a price to be determined later. The Company has taken steps to amend its articles of incorporation so as to provide for the issue of first preferred stock. The Company desires also authority to convert its present issue of $10,000,000 of preferred stock into first preferred stock after July 1, 1916, at the rate of 1.025 shares of first preferred stock for each share of the present preferred stock. The new first preferred stock which the Company proposes to issue will be 6% cumulative. The Company proposes to use the proceeds to be derived from the sale of its stock for the purpose of liquidating outstanding notes in the sum of $7,000,000, and for the purpose of carrying on the additions and betterments to the Company's plant at Lake Spaulding and in other parts of its system. Authority is requested to use approximately $1,000,000 of the proceeds from the sale of its stock for the purpose of meeting sinking fund obligations during the year 1914. The Company asks for authority to devote the proceeds from the sale of its bonds for purposes hereafter to be specified and determined.

Santa Paula Water Works reports for 1913 as follows:

ASSETS

Fixed capital	$184,205.52
Cash	1,606.15
Accounts receivable	14,600.00
Investments	1,300.00
Other assets	3,124.72
Total	$204,836.39

LIABILITIES

Capital stock	$150,000.00
Accounts payable	14,700.00
Reserves	3,976.57
Other liabilities	223.23
Surplus	35,936.59
Total	$204,836.39

PROFIT AND LOSS

Operating revenue	$ 17,741.21
Operating expenses	8,308.69
Net operating revenue	$ 9,432.52
Non-operating revenue	655.41
Net balance	$ 8,777.11
Balance December 31, 1912	33,909.48
Total	$ 42,686.59
Dividends	6,750.00
Balance	$ 35,936.59

Laguna Cliffs Water Co. of Los Angeles reports for 1913 as follows:

ASSETS

Fixed capital	$23,608.14
Accounts receivable	1,865.81
Deficit	2,185.37
Total	$27,659.32

LIABILITIES

Capital stock	$15,200.00
Accounts payable	2,205.00
Other liabilities, assessments	10,254.32
Total	$27,659.32

PROFIT AND LOSS

Operating revenue	$ 432.00
Operating expenses	1,047.50
Net operating deficit	$ 615.50
Deficit December 31, 1912	1,569.87
Total deficit	$ 2,185.37

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Construction News Summary

Condensed From Our Daily Construction News Service.

CALIFORNIA

AETNA—Bond issue has been authorized providing $21,000 for new sewers. Plans are being prepared.

ALAMEDA—City Council has ordered bond election providing $200,000 for improving Alameda waterfront.——City Council has adopted plans and specifications for sewer in Madison St. Bids will be called.——City Council has ordered a bond election to provide $200,000 for various waterfront improvements. These funds will be expended for construction of wharf on city property at north end of Grand St., on sewer adjacent to United Engineering Works, repairs to Oak St. wharf, and constructing new streets from Webster St. to wharf. City Council has recommended providing $100,000 in next tax budget for new street work. Street committee has recommended 4-in. concrete base with 1½-in. asphalt concrete wearing surface.

ALBANY—Bond election was held on August 10 to provide $12,000 for fire-alarm system.——City Trustees are considering construction of a 100-ft. boulevard. Charles L. Huggins is city engineer.

ANDERSON—Work on the final survey for the Anderson Cottonwood Irrigation Project has been commenced at Turtle bay by H. H. Henderson, engineer. Estimates will be completed and bond issue called as soon as the survey is finished.——The Northern California Irrigation Association has been incorporated by W. C. Barkuloo, N. T. Howell, George W. Thompson, L. W. Nelson, H. L. Story, A. J. Shields, Dennis Desmond, Roscoe J. Anderson, and E. G. Carter. This is known as the Pit River Project; $10,000 is available immediately for engineering and investigating work.——Supervisors will call a special election to provide a lighting district for the town.

BAKERSFIELD—New assembly hall, cost $50,000, and gymnasium, cost $20,000, are to be built for the Kern County high school.——Mountain View school district will hold bond election September 5 to provide $8000 for school improvements.

BERKELEY—City Council is considering a plan for the installation of electroliers on Telegraph Ave. from Dwight Way to Derby St.——City Council has adopted a resolution providing for the purchase of an asphalt heater and mixer. Estimated cost $3000. E. O. Turner, commissioner. Plans and specifications have been adopted for opening Berkeley Way from West to Chestnut St. Oakland Paving Co. was the only bidder for improvement of section of Virginia and La Vereda streets. Concrete retaining walls will have to be built.

BIGGS—F. L. Brown, of this city, desires to let contract on rubble masonry bridge abutments. Address as noted.

CHICO—O. E. Tracy is organizing a company for the construction of a canning establishment.

CLAREMONT—City Trustees have awarded contract to Lon Fleming for Foothill Blvd. 5-in. concrete base. Price, $20,000.

CLOVIS—Estimates have been prepared for improving a number of city streets and also for replacing flume ditch with 30-in. concrete conduit. Mr. Jensen, city engineer.

CORNING—V. C. Miller, of Oakland, with E. B. Perrin and W. H. Jaeger, contemplate impounding water and constructing a hydro-electric power-plant on Dr. Perrin's ranch near this point.

DUNSMUIR—Contract has been awarded to Rufus Brain, of this city, for the construction of the Springs-McCloud cut-off road. Price, $5700.

DOWNING—A bond issue providing $35,000 for the erection of a new grammar school has been approved.

ESCONDIDO—State Board of Control will purchase $75,000 and private parties the balance of the $100,000 municipal water plant bond issue. Pumping station will be built along the Escondido river and impounding reservoir and distributing system will be constructed. The Escondido Utilities Co. will install a 225-hp. Diesel engine, using the present steam plant as a standby.

EXETER—The Exeter Board of Trade will build a monumental structure in the form of an archway at the junction of Pine St. and Southern Pacific railroad. The length of the arch will be 220 ft., and it will be fitted with electric lights and an electric clock. Reinforced concrete brick and stucco will be used throughout. A. Merrill Bowser, of Exeter, is the architect.

FOLSOM—The Granite School District has called for bids to be opened September 16 for a new school building. Estimated cost, $25,000. Furnishings, $5000. Plans and specifications may be seen at office of clerk of the Board of Trustees, Folsom, Cal., and at the office of George C. Sellon and Alden W. Campbell, architects, 1005 K St., Sacramento. D. E. Wiley, clerk.

FORT BRAGG—The city has applied to the California Railroad Commission for permission to purchase the privately owned water system of which H. F. Milliken is proprietor.

FRESNO—Contract for construction of Columbia School building has been awarded to R. C. Blackwell, of this city. Price, $27,375.——Bids will be advertised by the Board of Education for constructing Jackson School and Longfellow School. Ernest J. Kump is architect for the former, and Swartz, Hotchkin & Swartz for the latter.——City authorities have entered into an agreement to cancel contract amounting to $45,600 for installation of downtown electrolier street-lighting system, and another call for bids will be made.——Thomas E. Stanton, assistant division engineer of the California State Highway Commission, is authority for statement that a complete plant for road construction materials will be installed at this point.——Preliminary plans for the new Emerson Grammar School to be erected on the Hazelwood tract have been submitted to the Board of School Directors. Architects are Swartz, Hotchkin & Swartz; estimated cost, $85,000. The front will be finished in local pressed brick; wooden floor joints and steel frame. Main corridor on both first and second floors is to be floored with concrete slabs on steel girders; heating and ventilating plants will be placed in the basement.——J. B. Rodgers, president of the Fresno Interurban Railroad, states that construction work will commence immediately on the second unit of the road between Alvina Heights and Clovis. J. R. Kelly is general manager for the Company. Mahoney Bros., of San Francisco, are contractors.——Detailed estimate for cost of improvement on West Side Irrigation Project is as follows:

Grading McMullen grade to Jameson grade, 396,114 yd. at 14c., $55,455.96; auxiliary by-pass, 13,222 at 12, $1586.64	$ 57,042.60
Jameson grade bridge ($6500) and head-gates to main canal ($5000)	11,500.00
Engineering and superintendence	6,957.00
Work to be performed in grading:	
Levee 1, 554,126 yd. at $12c., $66,495.12; and levee 2, 395,000 yd., $47,400	113,695.12
Bridges ($16,000) and check in flood channel ($7500)	23,500.00
Rip-rap, 15 miles at $700	10,500.00
East side rights-of-way, 69,000 ft. by 1200 (1916 acres at $100 an acre), $191,600; west side, 11,640 by 900 (240.5 acres at $100), $24,050, and 33,200 by 600 (457.5 acres at $100), $45,750; total	261,000.00
Engineering and superintending	14,604.88
Interest	28,645.75
Total on future work	452,545.75
Maintenance during construction, upkeep, and repairs during bond issue life to July 1, 1942	40,000.00
Administration in organization and legal expense for two years	5,000.00
Legal during bond life	25,000.00
Draining and pumping plant	6,954.25
Total	$600,000.00

City supervisors have approved plans and estimates for Reclamation Project within District No. 1606. Trustees are J. R. Erskine, W. J. Marshall, and W. H. Tuttle. Total expenditure estimated at $600,000. Affected lands are under the control of the San Joaquin Valley Farm Lands Company.

GRASS VALLEY—Nevada County Water Consumers Association will call an election to establish an irrigation district under the Wright act.

HANFORD—Supervisors have rescinded action calling for bond election providing $675,000 for new roads, as the amount is in excess of 5% of valuation of county assessable property. Figures will be revised and election held in November.

HERMOSA BEACH—Board of Trustees has decided to hold a bond election on September 26 to provide $15,000 to build new city hall and fire station.

LASSEN—Company has been organized for the formation of an irrigation and drainage system. Capital stock, $62,500. Directors; John B. Christy, Ray Doyle, and Frank Decious.

LINDSAY—Contract for new school building will not be let until settlement has been made by bond purchasers. Lowest bidder was Henry Gede, of Fresno, $41,353.

LOS ANGELES—Harbor Commission has prepared plans for reinforced concrete warehouse, 150 by 600 ft., with foundation for 7 stories. Estimate, $175,000. Improvement of Pier-A St. will also be completed.——Board of Works has awarded contract for paving section of West Moreland Ave. to California-Arizona Construction Co. Price, $5329.49. Petition has been filed for improvement of a section of 10th St.——Board of Public Works has awarded a contract to Edgar T. Wheeler Co. for repairs to 6th St. bridge; price, $1360.——Contract has been awarded to the Mercereau Bridge & Construction Co. for under-

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pinning West Channel piers of the Macy St. bridge; price, $2566.——California-Arizona Construction Co. has the contract for filling to establish grade on portion of N. Figueroa St.——State Board of Supervisors has passed resolution instructing county treasurer to purchase $275,000 of State Highway bonds, supplementing previous resolution authorizing purchase of $225,000 bonds. These funds will be used for constructing State Highway in Los Angeles county, the main trunk line from Tejon pass to Bakersfield. Resolution has been passed authorizing construction of a highway through Antelope valley over the Ridge route.——Resolution has been passed asking the State to appropriate $400,000 for the construction of mountain roads in Los Angeles county, including the Arroyo Seco and San Gabriel Canyon routes.——Public Works Commission of City Council has approved assessment maps for paving section of W. 8th St. and Arlington St.——City Council has authorized Board of Public Works to advertise immediately for constructing reinforced concrete bridge at Ave. 43 over Arroyo Seco. R. W. Stuart, bridge engineer, has completed plans and specifications; $39,000 has been appropriated. East bank is to be protected by rock cribs. A concrete wall 17 ft. high is to be built on the west bank.——City Council is considering construction of a reinforced concrete wall instead of rip-rapping for protection of Arroyo Seco. The City Council has passed final ordinance for paving Vignes and Ducommon streets.——City engineer has prepared estimates for repairing 3rd St. tunnel. Chamber of Commerce has adopted resolution requesting that tunnel be lined with white tile or brick.——Total amount of projected street paving in the office of city engineer, to be laid August 1, was 81.738 miles.——Contract has been approved between the city and the Newell-Matthews Co. by which the latter is to furnish the city with six Studebaker air-pressure street flushers.——Contract has been awarded to Carl Leonardt for construction of 6-story reinforced concrete building for C. Q. Stanton and Western Electric Co. Cost, $40,000.——City Council has passed final ordinance for construction of Crocker Blvd. through Mound Hill, San Pedro. Bids will be called at once.——City building inspector has received plans and specifications for the Hewlett C. Merritt steel-frame 8-story building at 8th and Broadway. Estimated cost, $500,000.——Board of Public Works has awarded contract to James Kennedy Co. for improving section of Hollywood Blvd. and other streets. Price, $157,457.75.——City engineer has recommended to the City Council new sewers in section bounded by Sunset Blvd., west and south city boundaries, and Seward St.——City engineer has prepared plans for the improvement of a section of Figueroa St.——Plans are ready for the improvement of a section of Moneta Ave.——Proposal is under consideration to extend Pico Blvd. 14 miles from Main St. to Santa Monica.——City Engineer has presented to City Council ordinance for paving and building sidewalk on a section of Vernon Ave.——Ordinance has been presented calling for construction of sewers on a section of Moneta Ave.——Board of Works has awarded contract to E. L. Plantico for paving section of 54th St.; price, $13,365.06.——Petition has been filed with city clerk asking for opening of a section of Long Beach Ave. for a frontage of 57,768 feet.——Harbor Commission has awarded contract to Fairchild Gilmore Wilton Co. for paving Pier A St. at Wilmington. Price, $4400.

MARYSVILLE—Bids for the construction of the proposed 'D'-street bridge will be re-advertised to be opened on September 8. J. F. Eastman, County Clerk.

MERCED—San Joaquin' Light & Power Co. has approved plans for the construction of a new gas-holder at a cost of $8000, and other improvements for the Merced Valley substation for the Company. Company's office is at Bakersfield, Cal.——The Yosemite Lumber Co. will install three 150-kw. transformers for carrying high voltage between its sawmill and the planing mill at Merced Falls.——Roundhouse and repair shops of the Yosemite Valley railroad at this point were destroyed by fire on August 17. Loss, $100,000. O. W. Lehmer, general manager.

MODESTO—County Board of Supervisors has awarded contract for the construction of a bridge over Tuolumne river near Waterford to Mesmer & Rice. Price, $29,879. Other bidders were: Ross Construction Co., $31,784; Mervy Elwell Co., $30,775; Security Construction Co., $32,450.——No bids were received for the purchase of $610,000 improvement bonds for Modesto Irrigation District when Board of Directors met on August 15.——City Council has decided to open and extend Semple St.—Board of Supervisors has appointed John Sisk director for Division 3 of the Turlock Irrigation District.——City Council has decided to pave 7th and South Sts. over present paving to bridge.——City Commissioners will order pavement of entire length of state highway through the city.——It is reported that Mahoney Bros., of San Francisco, are contemplating construction of a railway from Turlock to the San Joaquin river.

MONTAGUE—The Standard Oil Co. will build a tank farm and distributing station at this point. E. J. Fowler is contractor and J. B. Wells is engineer for the Standard Oil Co.

NAPA—Board of Supervisors has delayed action on proposed Black Point cut-off road through Napa, Sonoma, and Marin counties by reason of the present unfavorable condition of the bond market.

OAKDALE—Movement to recall the directors of the Oakdale Irrigation District has failed. The old board has been re-elected and an issue of $400,000 bonds to complete the irrigation system will be submitted.——It is proposed to install a new headgate at Piedra on Kings river for the 76 Land & Water Co.; estimated cost, $2000. Mr. McKay, county surveyor.

OAKLAND—Lowest bidders for sections of Municipal Auditorium were as follows: Elevators and curtain hoists, Otis Elevator Co., $18,250; cement finishing, C. Christenson, $10,687; marble and tiling work, Jos. Musto Sons & Keenan Co., $21,285; finished hardware, Pierce Hardware Co., $5418.67; painting, Robert Swan, $7600; seating, Rucker-Fuller Desk Co., $20,235.65; lathing and plastering, Wm. Makin, $58,700; electrical work, W. Page McKenny & Co., $32,900.——City Council has awarded contract for improving section of 92nd Ave., Chetwood St., Weld St., Salisbury St., to the Hutchinson Co.; E. 27th St. and 23rd Ave. to E. H. Sundberg; Jefferson St. to Oakland Paving Co.; Maple Ave. to Ransome-Crummey Co.——Plans and specifications for improving section of Capell St. have been adopted.——City Council has awarded contract for improvement of Niles Canyon road to M. E. Fernandes; price, $23,780.95.——Fire at the asphalt plant of the Ransome-Crummey Co., on August 9, inflicted damages amounting to $5000.

OROVILLE—Board of Supervisors has awarded the contract for constructing two bridges in second district to Chico Construction Co. Price, $3165 and $4951.50, respectively.——O. N. Enslow has filed a water appropriation of 37,500 inches upon Feather river below Oroville. He is organizing an irrigation project.——Board of Supervisors has let contract for paving four blocks around Court House to Clark & Henery Construction Co.; price, $7202.——Board of Supervisors will receive bids until September 12, 11 a.m., for constructing two trestle bridges on old river road. C. F. Belding, clerk.——A new reinforced concrete bridge over Honcut creek is under consideration by the Yuba and Butte county supervisors. Bridge will be 168 ft. long and cost $6500. L. B. Crook is Yuba county surveyor, and Martin Polk, Butte county surveyor.——Bond issue of $12,000 has been approved for erecting new school in the Manzanita district.——City Council will consider resolution providing that irrigation ditches shall use concrete siphon or concrete and steel bridges for crossing county roads.

PESCADERO—Petition has been presented to the San Mateo county supervisors asking for appropriation for the construction of highway from Pescadero to connect with highway into the Sempervirens state park. Road will be 9 miles long and cost $2000 per mile.

PETALUMA—City Council has decided to call for a bond election to provide $75,000. Of this amount $45,000 will be expended for improvements on Thompson creek, including three bridges; $20,000 for improving E. Washington St.; and $10,000 for electroliers in business section.

POMONA—City Council has retained F. E. Trask, consulting engineer of Los Angeles, to appraise value of property of Consolidated Water Co. A proposal to purchase is under consideration.——City Council has granted franchise to the Pacific Electric railroad to construct a line from Lordsburg to North Pomona.

PORTERVILLE—City street department has prepared plans and specifications for paving five streets in the business district. Concrete base with asphaltic macadam wearing surface will be used.——City Trustees will re-pave sections of Grevilla, Lafayette, Second, and Hockett Sts.——City Council is considering project for the installation of a municipal gas plant. Estimates are being prepared by the city engineer.——Petition is being circulated calling for the improvement of Cleveland street.

RED BLUFF—Reclamation Service, in conjunction with Iron Canyon project, has reported favorably on condition of proposed damsite.

REDWOOD—The city has granted a permit to the Shell Co., Mills Bdg., San Francisco, for a gasoline distributing station.

REDDING—Supervisors have awarded contract for constructing steel bridge over Pit river to William Stephens of Redding; price, $2964.25. Other bids were: M. B. White, Stockton, $3500; Chico Construction Co., $3149.——The first regular meeting of directors of the Anderson Cottonwood Irrigation District was held at Anderson, August 11. Complete organization has been effected. Directors present: W. C. Barkuloo, A. F. Smith,

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McCoy Fitzgerald, and E. Dinsmore.——Three new bridges are to be built across Pit river by the county.

RICHMOND—City engineer is preparing plans for city boulevard running along the bay to Scofield Ave.——Board of Water Commissioners has established September 22 as the date for holding election providing $2,500,000 in a bond issue for city water system.——Contract has been let to G. W. Cushing for paving Cutting Blvd.; price, $88,454.79. Municipal Improvement Co. bid $92,242.89, and W. J. Schmidt, $88,811.81. Bitulithic will be used.——City Council has awarded contract for paving 25 blocks of Cutting Blvd. to the Municipal Improvement Co.; price $123,194.69. Federal Construction Co. bid $125,404.71.——Contract has been awarded to the Ransome-Crummey Co. for improving section of Cutting Blvd.; price, $67,421.11. Federal Construction Co. bid $79,082.35, and Municipal Improvement Co. bid $77,595.69.——Contract has been awarded to Ransome-Crummey Co. for paving 2nd and 23rd Sts. and Southern Pacific right-of-way; price, $48,878.50.——Contract has been awarded to Ransome-Crummey Co. for paving a section of 23rd St.; price, $14,372.72. Bitulithic pavement will be used.——Contract has been awarded to L. L. Page, of Richmond, for constructing Pullman Ave. lateral sewer; price, $8574.14.——G. W. Cushing will commence work at once paving a section of Pullman Ave. Price, $88,000.

RIO BONITO—Bond issue has been voted providing $6000 for building a new schoolhouse.

RIVERSIDE—Bids for furnishing 125,000 bbl. of cement for 100 miles of county highway have been submitted by Riverside Portland Cement Co. at $1.34 per bbl., and California Portland Cement Co. at $1.35 per bbl. Bids for crushed rock: Riverside Portland Cement Co., 65c.; screenings, 30c.; Pacific Rock & Gravel Co.: gravel 40c., sand 5c.

SACRAMENTO—California Highway Commission has placed contract with Parrott Bros., of Salt Lake City, Utah, for section of State Highway in Alameda county. Price, $20,779.70. ——John W. MacDonald, Jr., of San Jose, has received contract for section of State Highway in Santa Clara county. Price, $36,696.70.——Hard Bros., of Sacramento, have received contract for section of State Highway from Hopland to Ukiah. Price, $68,385.——Ransome-Crummey Co., of Oakland, has received contract for section of State Highway between Santa Clara and San Jose. Price, $30,664.50.——J. H. Falconer, of Escalon, has received contract for section of State Highway from San Pablo creek to Pinole. Price, $14,443.30.——Fairbanks & Baechtel, of Willits, has received contract for section of State Highway between Miranda and Dyerville. Price, $120,893.—— T. K. Beard, of Modesto, has received contract for section of State Highway between El Capitan creek and Alcatraz. Price, $82,168.——City Commission has awarded contract to U. S. Cast Iron Pipe & Foundry Co. for cast iron pipe. Amount, $3511.81. ——Contract has been awarded to Ambrose & Teichert for construction of sewerage pumping station. The city has obtained right-of-way for its main trunk sewers up to 16th St. City engineer has been instructed to make changes in plans for the new sump.——All bids for 75 fire hydrants have been rejected by the City Commission. Bids will be re-advertised immediately.——Board of Supervisors has postponed consideration of proposed county bond issue of $2,425,000 until the meeting of the Board on September 8. Legal opinions will be asked on the proposal to issue bonds as now framed.——Resolution of intention No. 1086, providing for improvements on H St., has been adopted. J. C. Nurse, superintendent of streets.——Following bids have been received by Board of Supervisors for construction of bridge at Walnut Grove: Jenkins & Wells, $77,650; Security Construction Co., $78,504; Ross Construction Co., $85,946; Matthews Construction Co., $88,000; Hyde, Harges & Co., $83,500; William Concannon, $89,900.——City Commission has passed Resolution No. 1079 for improving alley between E and F Sts.—State engineer McClure and road engineer Edward Goodwin, are planning road from Red Bluff to Eureka, 170 miles long. Appropriation will be requested at next session of legislature.——State Reclamation Board has levied assessment of $367,000 for Sacramento river outlet and $900,000 for Sacramento by-pass project. Karl L. Knight has been appointed deputy city engineer.——Reclamation District No. 1500, Sutter Basin project, has been ordered to construct north levee of Tisdale by-pass and west levee of Sutter by-pass. W. E. Gerber, Sacramento, general manager.——Resolution No. 1084, for improvement of alley between K and L Sts., has been approved.——Resolution No. 1083, providing for improving alley between H and I Sts. with concrete sidewalk, has been approved. M. J. Desmond, clerk City Commission.——The Superior Court has granted condemnation proceedings brought by the city for the acquisition of a site for a sewerage pumping plant.

SAN FRANCISCO—State Water Commission has granted permit to the Engels Copper Mining Co., Foxcroft Bdg., this city, for 60 sec. ft. on Lights creek, Plumas county. Preliminary permit has been granted to T. H. and W. A. Vestel for 3500 sec. ft. on the Pit river.——Board of Supervisors has ordered the improvement of Leland Ave. between Rutland St. and San Bruno Ave. by the construction of sewers and fittings. The same order has been issued for Schwerin St. between Visitacion Ave. and Sunnydale Ave., and on Visitacion Ave. between Britten and Rutland Sts.——Movement is under way to request Board of Public Works to grade and pave northern extremities of all streets in North Beach district, from Sansome and Hyde Sts. Green St. is to be paved between Mason and Taylor Sts. ——Project is under consideration for extending the Municipal Railway from Green St. and Columbus Ave. to the Embarcadero along Stockton St.——The Niland Water Co., of Niland, Imperial county, California, has applied to the Railroad Commission for permission to issue $50,000 in stock and $40,000 in bonds to provide funds to construct and operate a water system at Niland.——Board of Supervisors has ordered improvement of the following streets: Construction of curbs, sidewalks, culverts, and basalt blocks on Alameda St. and San Bruno Ave. crossing; resetting of curbs, constructing sidewalks, culverts, and asphalt pavement on crossing of 19th and Douglass Sts.; sewers and appurtenances on Silver Ave. bet. Boutwell and San Bruno Ave.; grading, concrete curbs, sidewalks, catchbasins, and culverts, asphalt pavement on Woolsey St. from San Bruno Ave. to Somerset St.——Appropriations made by the supervisors for preliminary work on Hetch Hetchy water project are in detail as follows: hydrography, $5000; roads, trails, etc., including railroad location, 7 aqueduct surveys, $13,750; water rights, $5000; office work, plans, etc., $5000; inspection and engineering in field, $5000; telephone lines, $2500; permanent camps, $2500; sundry expenditures, $61,151.29; borings to locate line of aqueduct, $20,000.——The Park Commissioners have decided to pave Stanyan St. entrance to Golden Gate park with asphalt. Contract has been awarded to A. J. Raisch & Co. at 5½c. per sq. ft.——Board of Public Works will readvertise for bids for the construction of Twin Peaks tunnel to be opened on September 16. A change is to be made reducing the amount of bond required.——Board of Works has recommended construction of building at Corporation Yard, 11th and Bryant Sts., for the use of the building and street repair, street cleaning, and sewer repair departments. Cost estimated $11,500.——The lowest bid for constructing the Potrero Emergency Hospital was that of Robert Trost, $18,347. ——Bids will be called by U. S. Treasury Department, Washington, D. C., for lighting fixtures for San Francisco custom house. ——Utah Construction Co. has commenced work on 12-mile highway for the Hetch-Hetchy water-supply project.

SAN DIEGO—The City Council has adopted a resolution providing for the expenditure of $435,000 for constructing the Bonita pipe-line complete, including reservoir and filtration plant. Preliminary surveys have been made. Bids will be called for. Charles H. Lee, consulting engineer, of Los Angeles, is acting for the city.——Plans for the 20-unit filtration plant have been prepared by H. A. Whitney, hydraulic engineer for the city water department; capacity, 12,000,000 gal. daily.—— Contract has been awarded to D. L. Bissell for first section of conduit, 16,700 ft. long, between Barrett & Morena Sts. Price, $40,979.——Contract has been awarded to Southwestern Foundries Co., of this city, for supplying and installing four-stage, direct-connected, centrifugal pump and motor. Price, $7911.

SAN GABRIEL—The city has decided to contribute a share of the cost of constructing a new bridge over Mill creek, to be built by the Pacific Electric railway, Pacific Electric Bdg., Los Angeles, Cal. Estimated cost, $9000.

SAN JOSE—County Board of Supervisors will receive bids until 11 a.m., September 8, for construction of a reinforced concrete bridge over Adobe creek. Harry A. Pfister, city clerk.—— County Board of Supervisors has awarded contract for bridge over Pajaro river to Security Construction Co.; price, $19,196. Mesmer & Rice bid $19,625.——Bids for concrete rubble wall on Campbell creek were Alfred Mattson, $8000; M. E. Kilcourse, $5845; J. McReynolds, $6290; R. H. Cooley, $3200; R. H. Jamison, $6800; Ashton & Bridgman, $6950.——Contract has been awarded to J. A. Mathewson for constructing reinforced concrete culvert on Harwood road. Bid $720.——Contract has been awarded to J. McReynolds for improving portion of Berryessa road; price, 50c. per yard for gravel; total, $2397.——Plans and specifications for highway lighting of Willow Glenn lighting district have been adopted. Bids will be opened September 8, 11 a.m.——County surveyor has been directed to prepare plans and specifications for improving portion of Alameda highway. Henry A. Pfister, clerk.

SANTA ANA—Bids have been called by the Board of Supervisors until September 2 for constructing a bridge across the Santa Ana river.

SANTA BARBARA—Bids for the construction of the West

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Blvd. seawall were as follows: Mercereau Bridge Co., D $55,679, E $46,392, F $57,790; Mesmer & Rice, D $69,448, E $61,000, F $53,000; Munoz & Munoz, D $64,093, E $58,812, F $58,812; Russell-Greene-Foell, D $62,950, E $59,450, F $69,300; Beatty Constr. Co., D $67,454, E $59,374, F $50,174; Ashton, Bridgman; Van Sant, Houghton, D $62,950, E $59,450, F $69,500; Thomas J. Shea, D $69,940, E $63,323, F $50,923.——County surveyor is investigating a project to construct a road from Hollister Ave. to the beach. A trestle 150-ft. long will be required.——City Council has adopted resolution of intention to change and modify the grade of Mason St. Resolution of intention has also been passed to construct 6-in. vitrified pipe sanitary sewer in a section of Haley St.——Plans and specifications for paving Hollister Ave. have been adopted.——Resolution to change grading on Mountain Drive is under consideration.——Resolution of intention has been adopted for the Amapamu St. sewer. ——Plans have been filed with the city supervisors for one of the proposed bridges of the State Highway over Eagle canyon. ——Supervisors have ordered preparation of plans for bridge over Gaviota creek.——Contract has been placed with Magnus Johnson for bridge over San Roqui creek; price, $6825.——Bent & Pennybaker were the lowest bidders for laying sidewalks around Court House Square; price, $0.1247 per sq. ft.——Plans and specifications have been submitted for paving portions of Broadway in Santa Maria and for grading and paving San Marcos turnpike to Cathedral Oaks.——A project for building a new road from Los Olivos to Ballard Field, a distance of about two miles, is to come before the City Council for definite action.——City engineer is preparing plans for re-paving Yanonali St.——City Council has passed ordinance giving county control of West Blvd. within city limits. County will reconstruct thoroughfare as a part of State Highway. County surveyor will make plans and specifications.——County Board of Supervisors has called for bids until 10 a.m., September 8, for construction of wagon-road in third road district. C. A. Hunt, clerk.——J. R. Chapman, engineer, has submitted to the Chamber of Commerce a plan for constructing a breakwater 800 ft. long, estimated cost $40,000.

SANTA CLARA—City Trustees are considering a proposition to complete state highway in town of Santa Clara. Bond issue providing funds amounting to $25,000 will probably be made.——Plans for re-paving city streets are under discussion. Bond issue providing $25,000 will probably be called. H. B. Fisher, city clerk.

SANTA CRUZ—City Council is considering project to construct a bulkhead along a portion of Branciforte creek.—— Site for the new high school has been purchased. Cost $17,000. Bids have been called for construction; reinforced concrete will be used. W. H. Weeks, architect, 75 Post St., San Francisco. C. D. Hinkle, city clerk.——Movement is under way to construct a reinforced concrete bridge over the San Lorenzo river. Estimated cost, $40,000.——Specifications are being drawn up by City Engineer Thompson for uniting the Union Construction Co.'s bridge to that of the city over the San Lorenzo river on Water street.

SANTA ROSA—Board of Supervisors has appointed Frank Glynn superintendent of construction for bridges at Wheatland Crossing.——Bids are called by City Council for curbs and gutters on a section of 14th St. Plans and specifications for curbs and gutters on a number of other city streets have been approved.——Sonoma county highway commissioners, W. B. Whitney, J. Edgar Allen, and J. C. Parsons for revised report on proposed highway system for Sonoma county. Bond election is to be called.

SAUSALITO—The Sausalito Inclined Street Railway Co., Geo. H. Harlan, has asked the State Railroad Commission for approval of plans for a funicular railroad. Cost $30,000

SOUTH PASADENA—City Trustees will call for bids on new municipal building. Norman F. Marsh, of Los Angeles, is architect.

SUISUN—A bond issue of $40,000 is under consideration for the construction of a new grammar school.——E. D. LeClare will build a public wharf 100 ft. long.

STOCKTON—County Board of Supervisors will receive bids until 10 a.m., September 8, for grading and leveling a portion of Jack Tone road for a distance of 29,200 ft. and installing culverts on same. Eugene D. Graham, clerk.——Bids have been called until 10 a.m., September 8, for grading and graveling McKinley Ave.——County purchasing agent has been authorized to purchase Kelly-Springfield 10-ton oil-burning road roller; price, $3050.——County surveyor has been directed to prepare plans and specifications for bridge over Calaveras river and for a bridge over Mokelumne river at Woodbridge.—— Bids have been called to 10 a.m., September 8, for graveling and installing culverts on a section of Jack Tone road.——City Council has adopted plans and specifications for paving Weber Ave. Bids will be open September 1. Two-inch asphaltic macadam wearing surface will be used on a 3-in. concrete base. ——City Commissioners have under consideration plans and specifications for concrete bridge over Mormon channel at Sutter St. Bids will soon be called.——U. S. War Department has approved plans for proposed bridges over the Old and Middle rivers. Bridges will be of steel construction, 26 ft. wide and 530 ft. long, with draw spans 260 ft. and approaches 135 ft. long.

TULARE—Contract for the construction of the new schoolhouse at Tipton has been let to Johnson & Benson, of Kingsburg; price, $18,469. Others bidders were: L. F. Platt, of Tulare, $21,450; Truitt & Shields, of Fresno, $21,000; Johnson Bros., of Kingsburg, $20,350; Henry Gede, of Fresno, $19,771; Ackerman & Heisel, of Fresno, $20,975; Riggins of Fresno, $28,011. ——Ordinance changing grade-level of all streets is under consideration by City Council. Re-paving will be necessary. H. E. Watts, of Exeter, acting city engineer.

TURLOCK—Committee appointed by the Turlock Board of Trade has recommended to the Turlock Irrigation District that a general manager be appointed to take charge of the operation of the entire system.——City Council has sold $15,000 bond issue for fire equipment.

VISALIA—Supervisors have postponed bond election providing for $2,500,000 for county highways. Bond issue is proposed to provide between $12,000 and $20,000 for purchase of motor hose-cart and chemical wagon.——Plans and specifications for new sewer system are being prepared by city engineer.

WATSONVILLE—City Board of Aldermen has passed resolution calling for a bond issue of $32,000 to build a new bridge over Pajaro river; to purchase automobile fire-engine, fire hose, and a modern fire-alarm system. Bridge will be made of reinforced concrete. Estimated cost, $20,000. Mr. Kitchen, city engineer.——The Pajaro Protection district has been reorganized and plans are under way for a scheme of flood control of the Pajaro river.

WINTHROP—Petition has been presented to supervisors to build bridge across McCloud river and build new road from Winthrop through Copper City.

OREGON

ASTORIA—Port Commission has approved plans for a superstructure for the new municipal docks. Bids will be called to be opened about September 1.

EUGENE—Ralph B. Hunt is engineer for a new reclamation project involving 50,000 acres west of this city. Petitions for its formation are in circulation. Estimated cost of development, $85,000.——Federal Government officials have finally approved Alsea highway project. One and one-third miles of new road must be built. Estimated cost, $3000. H. B. Rankin, supervisor, Siuslaw National Forest.

PORTLAND—Bids of $2.34 per bbl. within the half-mile radius and $2.55 per bbl. within the 4-mile radius for portland cement submitted by F. T. Crowe & Co., the Standard Portland Cement Co., and the Henry Cowell Lime & Cement Co., being identical, have all been rejected by the City Commission. Cement amounting to 5000 bbl. will be purchased in the open market.——By reason of decision handed down in the Circuit Court, immediate construction will be undertaken of the surface pavement for the base-line road.——City Commission has awarded contract for paving a section of Greenwood Ave. with bitulithic to Warren Construction Co., price $2410.80; a section of Market St. drive to Harry Howard, concrete $5734.64; a section of Eugene St. to Oregon Independent Paving Co., asphaltic concrete $5633.69; a section of San Rafael St. to Warren Construction Co., asphaltic concrete $3636.33; a section of Clackamas St. to Giebisch & Joplin, asphaltic concrete $3475.57; a section of Grand Ave. to Oregon Independent Paving Co., asphaltic concrete $2420; the Alameda to Giebisch & Joplin, asphaltic concrete redress $71,884.41; section of Texas St. to Oregon Hassam Paving Co., class 'B' Hassam $2420.06; section of E. 27th St. to Warren Construction Co., asphaltic concrete $2648.17; section of Patton Ave. to Oregon Independent Paving Co., asphaltic concrete $61,614.83.——Proceedings are under way for the extension of Union Ave. for a distance of ½ mile, width of 80 ft.——Commission of Public Docks will sell bonds amounting to $150,000 for construction of 1-story warehouse at Municipal Dock No. 1; two electric automobiles for freight handling will be purchased. G. B. Hegardt, chief engineer. East Water St. in front of Dock No. 2 is to be paved with Belgian blocks.——Bids have been opened by the City Council for a large number of street and sewer improvements. Bids are being tabulated and notice of award of contract will be made later. ——Water Works Board will order installation of more than 5 miles of 12-in., 16-in., and 30-in. water mains in the Irvington and Burnham districts. Estimated cost, $156,000. Mr. Clark, water engineer.

ST. JOHNS—Warren Construction Co. has offered to improve

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a section of Columbia Blvd. with gravel, bitulithic pavement for $1.45 per cu. yd. plus 50c. for excavations.

WASHINGTON

ABERDEEN—Representatives of Aberdeen, Hoquiam, Cosmopolis, Montesano, Elma, and Satsop have decided to combine in the organization of a water district. Water will be secured from the headwaters of the Wynoochee river. Assessed value of the property of the new water district, for which a tax levy will be made, is over $14,000,000. It is proposed to bond the district for $1,000,000 and construct a pipe-line 23 miles long.

CENTRALIA—The Town Council at Winlock has been instructed to call for bids for new town hall. Bids will be opened at first meeting of Council in September.

COLFAX—A section of permanent highway is to be built between Colton and Uniontown, to be known as Highway No. 7-A. Highway No. 7, from Colton, is to be extended 2000 ft. to join the street paving of Uniontown.

COLVILLE—Contract has been awarded to E. D. Miner, of Sand Point, Idaho, for constructing 3½ miles of road. Cost $9497.

ELLENSBURG—Bond issue has been approved to provide funds for installing auxiliary steam pump for municipal water system.

GRAND VIEW—Proposed bond issue providing $3800 for new schoolhouse near Euclid has been defeated.

NEWPORT—Newport school district has voted $5000 bonds for equipping and completing new high school building.

OLYMPIA—City Council has adopted resolution providing for installation of new cast iron water mains in paving district south of 7th St.——City Council is considering an arrangement with the Washington Public Service Corporation providing for the installation of water mains in various side streets.——City Council has awarded contract to the Washington Paving Co. of Tacoma for asphalt and bitulithic paving on certain streets. Total approximately, $80,000; asphalt paving, $1.30 per sq. yd.; bitulithic, $1.45 per sq. yd.——Modern Mill Co. has been incorporated by A. E. White, J. W. Dent, H. E. Sandberg of Tacoma, and A. J. Bartholomew and A. J. Gaisel of Gate as incorporators. Lumber mill plant will be built.

OROVILLE—West Okanogan Valley Irrigation District, with co-operation of Great Northern Railway, will construct irrigation canal to supply water to 12,000 acres.

SEATTLE—County commissioners have awarded contract to Firsch & Glass for the construction of a boulevard on Mercer island; price, $51,491.42.——Board has awarded contract to W. N. Ball for paving section of Rainier Blvd., 1.4 mile long; price, $39,470.61.——Bids have been called by the town of Cashmere until 8 p.m., September 14, for construction of sub-sewer on Washington street. Address Nick Walter, town clerk.——H. M. Chittenden, president Port Commission, has submitted plan for opening and constructing a trunk highway from the downtown district to Lake Washington by way of Rainier valley. Plans are in the hands of city engineer Dimmock.——Lowest bid received by Port Commission for new grain elevator was from Boyjohn, Arnold & Co., $178,050.——County Commissioners have awarded contract for construction of a steel bridge at Franklin to Chas. G. Huber. Price, $26,569.

SPOKANE—City Council has opened the following bids for street paving: Grading, curbing, and paving section of Broadway: Spokane Bitu-Mass Paving Co., for bitu-mass on concrete base $7325, city's estimate $7600; Mitchell Bros., asphalt $6999, estimate $7700; General Construction Co., for Hassam concrete paving $7000, estimate $7800; C. M. Payne, wood blocks $13,250, estimate $15,500. For Post St. from Mallon Ave. to Broadway: Spokane Bitu-Mass Paving Co., for bitu-mass on concrete base $2290, estimate $2500; Mitchell Bros., asphalt $2303, estimate $2500; General Construction Co., for Hassam paving $2200, estimate $2600; C. M. Payne, wood blocks $4024, estimate $4100.——Petition is under consideration by City Council providing for construction of Spokane Hillyard Highway. Estimated cost $70,000.——F. K. McBroom, Commissioner of Public Works, has decided to submit the question of selection of type of paving for Broadway and Post Sts. to the City Commissioners. Paving under consideration includes bitu-mass, bituminous No. 1 and Hassam concrete. Mr. McBroom has expressed the opinion that, at the same price, concrete is preferable.

STEILACOOM—An election was held on August 25 to authorize a bond issue for the purpose of providing funds for the acquisition of a municipal lighting and heating plant; amount, $10,000.

TACOMA—The State Supreme Court has ruled favorably concerning the validity of the $35,000 bond issue for building the tide flats municipal car line. Requests for bids for rails, pile driving, and lumber are being prepared in the office of the city engineer, Mr Raleigh. Cars will be operated by the Tacoma Railway & Power Co.——City Council has adopted Resolution No. 6404, providing for grading and laying sidewalks on section of Stevens St.——Resolution No. 6394, providing for certain sidewalk improvements, has been approved. Ordinance No. 5838, providing for improving sections of S. 8th St., has been approved. Resolution No. 6395, providing for improvement on S. 64th St., has been approved.——Northern Pacific railroad will repair coal bunkers and put in new concrete foundations; cost $35,000.——City Water Commissioner Drake has asked for appointment of two hydraulic engineers, for light and water department, at salaries of $250 and $150 per month.——Resolution No. 6399, for laying cement concrete sidewalks on a section of L St., and Resolution No. 6400 for construction of 8-in. sanitary sewer between East F and East G Sts., have been adopted. W. D. Nickeus, city clerk.——Resolution No. 6395, providing for construction of cement concrete sidewalks on S. 64th St., and Resolution No. 6394, for cement sidewalks on Washington St., have been passed. W. D. Nickeus, city clerk.——Project is under consideration for the installation of a second pipe-line from the city to MacMillan reservoir, and a pipe-line from South Tacoma wells to pump station B on Center St. Estimated cost is $400,000 for the former and $30,000 for the latter.——Commissioner of Public Works has called for bids until 12 noon September 8 for special track material for the Tacoma Municipal Street Railway line in S. 11th St. Owen Woods, commissioner.——Bids submitted to the Pierce and King county commissioners for work on Murphy cut-off and furnishing machinery for the river improvement project have been rejected and new bids will be called by the city engineer, W. J. Roberts, Tacoma Court House. $150,000 has been provided.——Resolution No. 6405, providing for cement concrete sidewalks on certain city streets, has been adopted.——W. J. Roberts, engineer, has reported on a two-county river improvement project for Pierce and King counties. County commissioners at Seattle.

TOPPENISH—Bids have been called by city clerk until September 7 for additions to water works system, including 75,000-gal. tank and 15,000 ft. of cast iron pipe. C. A. Wyckoff, city clerk.

WALLA WALLA—County Commissioners have awarded contract to Chas. G. Huber for constructing bridge across the Touchet river. Price $8697 for steel, $9890 for reinforced concrete.

WENATCHEE—The Wenatchee Valley Water Users' Protective Association has been organized, and an executive committee, consisting of Conrad Rose, J. A. Gellatly, and C. T. Haskell, has been appointed.——Proposal to organize an irrigation district has failed of approval by voters.

YAKIMA—J. M. Gaylord, engineer for U. S. Reclamation Service in Los Angeles, is in this city preparing estimates for new pumping plants to be constructed at Outlook and Snipes mountain. He will also prepare estimates for new pumping plant to be installed at Okanogan.——The Union Gap Water Users' Association has approved an issue of $90,000 in bonds for the installation of steel flume and re-lining ditches.——City Council is preparing specifications for new fire station.

Commercial Paragraphs

Orenstein-Arthur Koppel Co. has removed its offices to 241-7 Rialto building.

The Supervisors of Kern and Sonoma counties are using 'Big-an-Little' mixers in the buildings of concrete culverts.

Roadamite Paving & Supply Co., of Redwood, California, is using a carload of Watson dump wagons and a Hoass scarifier in their work.

W. A. Douglas, of the Byron Jackson Iron Works, has returned to his San Francisco office after a trip to New York and other Eastern cities.

Pacific Gas & Electric Co. is using a Pawling & Harnischfeger traction power tamper to pack back-fill in service mains. Edward R. Bacon Co. is agent.

Frank A. Harvey of Langford Felts & Myers, has returned to his Los Angeles office after placing S. S. Weeks in charge of the San Francisco office at 667 Mission Street.

Parker & Sons, of Sacramento, California, are now using a 'Little Wonder' gasoline driven concrete mixer purchased from the A. L. Young Machinery Co. of San Francisco.

Busch-Sulzer Bros.-Diesel Engine Co. has prepared for free distribution among engineers and others interested, a reprint of Dr. Diesel's address before the American Society

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of Mechanical Engineers on 'The Present Status of the Diesel Engine in Europe,' and a few reminiscences of the pioneer work in America.

FRANK O. BLAKE, SECRETARY for EL OSO ASPHALT CO., is touring the Pacific Northwest. The address of the Company is 624 Lissner Bdg., Los Angeles, California.

CALIFORNIA HIGHWAY COMMISSION has just purchased five Kelly-Springfield road rollers from the A. L. YOUNG MACHINERY Co. of San Francisco for use in the road maintenance department.

CITY OF VALLEJO, California, has placed an order with the A. L. YOUNG MACHINERY CO. of San Francisco for 600 street signs as manufactured by the CALIFORNIA METAL ENAMELING Co. of Bairdstown, Colorado.

WILLIAM OGDEN is now associated with EDWARD R. BACON COMPANY in its San Francisco office. Mr. Ogden's experience as western representative for the TROY WAGON WORKS will stand him in good stead in handling haulage problems.

EDWARD R. BACON COMPANY reports that for the first time in 90 days it is able to make delivery of Foote paving mixers. A 22-ft. capacity Foote mixer has been shipped to the Lee Moor Contracting Co. at Lancaster, California, for use on the state highway in Los Angeles county.

THE BARBER ASPHALT PAVING CO. has put into use at Rio Honda a Negley overhead cable excavator operated by a Thomas electric hoist. The entire outfit was furnished by the LELAND EQUIPMENT CO. of San Francisco, a similar outfit being used by the LOS ANGELES BRICK & TILE COMPANY.

THE HAYNES UNIVERSAL road machine is becoming increasingly popular for dressing and re-surfacing oiled roads. City of Hanford, Kern county, California, J. N. Brush, supervisor of Kern county and T. E. Shafer of Fresno have recently taken delivery. Haynes specification for constructing oiled streets has been adopted for Fresno, Hanford, Kingsburg, and Exeter.

TERRY STEAM TURBINE CO. of Hartford, Connecticut announces the appointment of FIDANQUE BROS. & SONS of New York and Panama, with main office at 15 Whitehall St., New York, as its representative for the Republic of Panama and the Canal Zone. Announcement is also made of the removal of its Cleveland office, in charge of L. G. FINLAY, to 503 Union building.

LYONS ATLAS DIESEL ENGINE CO., report that the largest Diesel engine ever built in the United States will constitute the first piece of heavy machinery taken through the Panama canal. The engine is of the vertical, four-cylinder type and develops 690 horse-power. It is destined for the plant of the Hawaiian Commercial & Sugar Co., and will be used for the operation of irrigation pumps of 15,000,000 gallons capacity.

THOMAS H. COLLINS, promotion engineer for the paving brick department of the DENNY-RENTON CLAY & COAL CO., of Seattle reports the receipt of many orders as the result of his trip through California during August. Paving brick made by the DENNY-RENTON CO. is now being used in San Diego, Santa Barbara, San Francisco, and Oakland. The same company is also supplying paving brick for a number of miles of county highway radiating out from Seattle, Washington.

Society Meetings

The Second International Safety Exposition will be held in New York December 12-19 at the Grand Central Palace under the direction of the American Museum of Safety.

A special meeting of the Board of Directors of the American Road Builders Association was held at the Hotel Astor, New York, on July 17. It was unanimously voted to hold a joint meeting with the American Highway Association either in San Francisco or Oakland during the Panama-Pacific Exposition, 1915.

Personal

FRANK C. MILLER has been appointed city engineer for Sacramento, California.

CLAUS JOHNSON of Turlock, California has been elected a director of the Turlock Irrigation District.

W. H. KELSEY has been appointed assistant in the bureau of Mechanical Inspection for Sacramento, California.

J. S. STEVENS has resumed consulting engineering practice at Portland, Oregon with offices in the Spalding building.

C. J. ERICKSON, one of the largest grading contractors of Seattle, is making an extended trip through California.

M. J. FALKENBURG, of Falkenburg & Laucks, Seattle, Washington has returned after an extended trip to California.

W. A. KRANER has opened consulting engineering offices in Portland, Oregon, specializing on power plant design and installation.

PAUL HILL has resigned his position as superintendent for the Lost Hills property of the General Petroleum Company, and has been succeeded by W. RYERSON.

F. E. WHITLOCK has resigned his position as superintendent of overhead and third rail for the Northern Electric Railway Company and has been succeeded by RUSSELL GOULD of Chico, California.

E. C. DILLARD of the U. S. Reclamation Service has been engaged in an examination of the Shasta County, California assessment roll in connection with the proposed Iron Canyon Irrigation project.

R. H. DEARBORN and C. J. GREEN, engineers for the Oregon State Railroad Commission are making a physical valuation of the plant of the California-Oregon Power Company at Klamath Falls, Oregon.

R. L. MORRISON, highway engineer for the United Gas Improvement Company of Philadelphia, has been appointed professor of highway engineering for the Agricultural and Mechanical College of Texas.

J. B. LIPPINCOTT, formerly engineer for the Los Angeles aqueduct, has been appointed consulting engineer for the Public Utilities Commission of Denver, Colorado with relation to its proposed new water system.

HAROLD A. PETTERSON, formerly superintendent for the Union Oil Company of California, has sailed for China where he has been appointed professor of structural and hydraulic engineering at the University of Pei Yang.

T. H. SCANDRETT has resigned his position as superintendent for the Crocker-Huffman Company at Merced, California and has been succeeded by J. T. FLANAGAN, who was formerly identified with the Chowchilla project.

EDWARD H. BENJAMIN, of San Francisco, consulting mining engineer, has been appointed president of the Mariposa Commercial & Mining Co. with offices in the Merchants' Exchange building, and will assume active management of the property.

J. R. BIBBINS, who was associated with BION J. ARNOLD in his investigation of San Francisco's transportation problems, has been retained by the law department of Pittsburgh in connection with the projected improvement of transportation conditions in that city.

A. L. COWELL of San Francisco, M. N. NEWMARK and HAROLD A. DELLMAN of Los Angeles have been appointed by Governor Johnson of California to serve as delegates to the Interstate Irrigation Commission which will meet at Helena, Montana during the week of October 1.

LIEUT. COL. T. H. REES, COL. WM. BLACK, COL. F. ABBOTT, COL. L. H. BEACH, LIEUT. COL. W. E. WINSLOW, MAJOR C. W. KUTZ, LIEUT. COL. HENRY TAYLOR, and A. H. WEBER, members of the U. S. Harbor Board of Engineers have been on a tour of inspection of Pacific Coast harbors.

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